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The Engineer

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Cordeaux and Avon Dams for Sydney Water Supply
(With a Two-Page Supplement).

May Engineering Notes.

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The Motor Cargo Ship Dalgoma.

New Gasworks at Carlisle—No II.

The Institution of Engineers of Australia.

French Policy and British Trade.

The Rotherham Electric Power Station.

PUBLIC NOTICES

The Government of Zanzibar has FOR SALE GENERATING PLANT, consisting of Three Bollies and Morcom Enclosed Compound Engines, 13in. and 22in. by 9in. stroke, 400/450 r.p.m., designed to give 260 B.H.P. at 125 lb. steam pressure, direct coupled to Compound Wound D.C. Generators, by the Electric Construction Co., to give 175 K.W. at 240 volts. Also Four Smoke-tube Boilers, each 150 H.P., One Wheeler Condenser, Water Heater, and Feed-water pumps.

This plant is at present at Zanzibar, but further particulars may be obtained from the CROWN AGENTS FOR THE COLONIES, Engineering Contracts Department, 4, Millbank, Westminster, S.W. 1.

Offers to purchase should be addressed to the CROWN AGENTS FOR THE COLONIES. 2493

Assistant Engineer REQUIRED for the PUBLIC WORKS DEPARTMENT of the GOVERNMENT of the STRAITS SETTLEMENTS, for three years' service with prospect of permanency. Salary 400 dollars a month, rising to 800 dollars a month by annual increments of 25 dollars a month, plus a temporary non-pensionable allowance of 10 per cent. The exchange value of the dollar is sterling is at present fixed by the Government at 2s. 4d., and its purchasing power in Malaya is considerably less than that in the United Kingdom. Free passages provided. Candidates, aged 25 to 35, unmarried, must be Associate Members of the Institution of Civil Engineers, and have passed the full examination of the Institution of Municipal and County Engineers, and have had at least three years' practical experience (exclusive of pupilage) as Engineering Assistants under an Engineer who is a Member of the Institution of Civil Engineers.—Apply at once by letter, giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/11,956. 2641

Senior Hydraulic Engineer REQUIRED by the GOVERNMENT of the GOLD COAST for the PUBLIC WORKS DEPARTMENT, for two tours of not less than twelve nor more than eighteen months, with possible extension. Salary £960 a year, plus duty allowance at the rate of £240 a year. Liberal leave in England on full salary. Free quarters and passages. Candidates, not over 45 years of age, must be Members or Associate Members of the Institution of Civil Engineers. They must have had experience in the Design and Construction of large Waterworks, Dams, Pumping Machinery, Purification Plants, &c., and in the handling of native labour.—Apply, at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/12,039. 2640

The University of Sheffield.

PROFESSORSHIP OF MECHANICAL ENGINEERING.

The Council of the University invite APPLICATIONS for the above POSITION, shortly to become vacant.

Applications should be received by the undersigned, from whom further particulars may be obtained, by the 12th June.

W. M. GIBBONS,
Registrar.

2332

Aberdeen Corporation Water-Works.

EXTENSIONS 1920.

CONTRACT NO. 10.—NEW AQUEDUCT.

The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into a contract for the MANUFACTURE and DELIVERY of about 3 MILES of 4ft. diameter PIPES and SPECIALS of the following alternative types, viz.:—

(a) Cast Iron.
(b) Mild Steel (Lap-welded).

The drawings may be inspected and specification, schedule of quantities and form of Tender obtained, on and after 30th May, 1923, on application at the Water Engineer's Office, 41½, Union-street, Aberdeen. Early application is desirable and no specification will be given out after 8th June.

For each specification of each type a deposit of Five Pounds sterling will be required, which sum will, after a Tender has been accepted, be returned to the tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification and schedule of quantities provided, with the schedule of quantities fully priced out in detail, and shall not have withdrawn the same.

Tenders, on the forms prescribed and enclosed in securely sealed envelopes, endorsed "Tender for New Aqueduct Piping," are to be addressed to the undersigned. No Tender delivered after 5 p.m. on the 22nd June, 1923, will be considered.

The Town Council do not bind themselves to accept the lowest or any Tender.

GEORGE MITCHELL, M. Inst. C.E., F.G.S.,
Water Engineer.

Water Engineer's Office,
41½, Union-street, Aberdeen,
21st May, 1923. 2548

Aberdeen Corporation Water-Works.

EXTENSIONS 1920.

CONTRACT NO. 11.—NEW AQUEDUCT.

The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into a contract for the TRANSPORTING, LAYING and JOINTING of about 3 MILES of 4ft. PIPING and ANCILLARY WORKS between Culter and West Cults.

The drawings may be inspected and specification, schedule of quantities and form of Tender obtained, on and after 30th May, 1923, on application at the Water Engineer's Office, 41½, Union-street, Aberdeen. Early application is desirable and no specification will be given out after 8th June.

For each specification a deposit of Five Pounds sterling will be required, which sum will, after a Tender has been accepted, be returned to the tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification and schedule of quantities provided, with the schedule of quantities fully priced out in detail, and shall not have withdrawn the same.

Tenders, on the forms prescribed and enclosed in securely sealed envelopes, endorsed "Tender for Aqueduct Pipe Laying," are to be addressed to the undersigned. No Tender delivered after 5 p.m. on 22nd June, 1923, will be considered.

The Town Council do not bind themselves to accept the lowest or any Tender.

No person should Tender unless thoroughly experienced in the actual construction of extensive public works.

GEORGE MITCHELL, M. Inst. C.E., F.G.S.,
Water Engineer.

Water Engineer's Office,
41½, Union-street, Aberdeen,
21st May, 1923. 25

PUBLIC NOTICES

Administrative County of London.

RECONSTRUCTION AND WIDENING OF WICK-LANE BRIDGE, HACKNEY.

The London County Council invites TENDERS for the RECONSTRUCTION and WIDENING of WICK-LANE BRIDGE over the Hackney Cut, in the Metropolitan Borough of Hackney.

Persons desiring to submit Tenders may obtain the form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring Gardens, S.W. 1, upon payment of the sum of £3. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 18th June, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
2404 Clerk of the London County Council.

Amersham Rural District Council.

CHESHAM BOIS DRAINAGE, CONTRACT NO. 4.

TO CONTRACTORS.

The Amersham Rural District Council are prepared to receive TENDERS for the CONSTRUCTION of about 2069 YARDS of STONEWARE and CAST IRON SEWERS of 7in., 9in. and 12in. diameter, together with MANHOLES, FLUSHING TANKS and other appurtenant Works, in accordance with plans and specifications prepared by Messrs. John Taylor and Sons, Civil Engineers.

Copies of the specification and bill of quantities, with form of Tender, may be obtained and the drawings may be seen at the offices of the Engineers, 36, Victoria-street, Westminster, S.W. 1, upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

Sealed Tenders, endorsed "Chesham Bois Drainage," addressed to the undersigned at his offices, Amersham, before 10 a.m. on Friday, the 15th June, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

By Order,
W. J. STANDRING,
2575 Clerk to the Council.

City of Oxford.

RECONSTRUCTION OF SEACOURT BRIDGE.

Oxford Corporation invite TENDERS for the RECONSTRUCTION of SEACOURT BRIDGE. The work consists of a Pile Foundation and Concrete Superstructure.

Plans may be seen at my office, and specification, quantities and forms of Tender will be supplied to responsible contractors on receipt of a deposit of £5 5s. The deposit will be returnable on receipt of a bona fide Tender.

Sealed Tenders, addressed to me and marked "Seacourt Bridge," should be delivered by 10 a.m. on Saturday, July 7th, 1923.

The lowest or any Tender will not necessarily be accepted

J. E. WILKES,
City Engineer.

City Engineer's Office,
Town Hall, Oxford,
30th May, 1923. 2607

County Borough of Portsmouth.

TENDERS are INVITED for :—

(a) The REMOVAL of a 60ft. ELECTRICALLY OPERATED BASCULE BRIDGE, and/or

(b) The PURCHASE and REMOVAL of same.

For further particulars and illustration of bridge see page 3.

F. J. SPARKS,
Town Clerk.

Town Hall, Portsmouth
17th May, 1923.

PUBLIC NOTICES

County of London.

The London County Council invites TENDERS for a FUEL ECONOMISER having 360 tubes, for Abbey Mills Pumping Station, Abbey-lane, Stratford, E. 15.

Persons desiring to submit Tenders may obtain on and after Monday, 4th June, 1923, the drawing, specification, form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring Gardens, S.W. 1, upon payment of the sum of £2. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the drawing, specification and other contract documents may be inspected at the Old County Hall before payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 18th June, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
2624 Clerk of the London County Council.

Great Northern Railway (IRELAND).

TO BRIDGE CONTRACTORS.

The Directors are prepared to receive TENDERS for :—

RECONSTRUCTION of BRIDGE No. 20, between Howth Junction and Portmarnock, and

REPAIRS to GIRDER WORK of BRIDGE No. 134, between Castlebellingham and Dundalk.

The drawings and specification may be inspected at the Engineer's offices, Dublin and Belfast, and copies of same, together with form of Tender, may be obtained from the undersigned on payment of One Guinea, which will be refunded on receipt of a bona fide Tender and return of the drawings.

Tenders, made out on the forms supplied by the Company, should be delivered under sealed cover, endorsed "Tender for Bridgework," not later than 10 a.m. on Thursday, 21st June, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

J. B. STEPHENS,
Secretary.

Amiens-street Station,
Dublin, 30th May, 1923. 2654

The Madras and Southern Mahratta Railway Company, Ltd.

The Directors are prepared to receive TENDERS for—

34 BOGIE CARRIAGE UNDERFRAMES, I.R.C.A. Standard Type.
20 FOUR-WHEELED BRAKE VAN UNDERFRAMES (25 Tons), I.R.C.A. Standard Type E. 1.
4 BOGIE CARRIAGE UNDERFRAMES, I.R.C.A. Standard Type.
5 FOUR-WHEELED BRAKE VAN UNDERFRAMES (25 Tons), I.R.C.A. Standard Type E. 1.
4 BOGIE TRUCKS, 10ft. wheel base, I.R.C.A. Standard Type.
2 BOGIE TRUCKS, 16ft. wheel base, M. and S.M.R. Standard Type.

All the above vehicles are for the broad-gauge section, and all are to be supplied WITHOUT WHEELS AND AXLES.

The Tenders are to be in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 26th June, 1923, and marked "Tender for Underframes, &c."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices,
25, Buckingham Palace-road
Westminster, S.W. 1.
29th May, 1923 2642

PUBLIC NOTICES

Port of Bristol.

NEW ELECTRIC CRANES, BRISTOL DOCKS.

The Docks Committee are prepared to receive TENDERS for the CONSTRUCTION of TWO 2-TON MOVABLE ELECTRIC JIB CRANES and the ERECTION of the same on the roofs of Sheds "Y" and "Z," Canon's Marsh, Bristol Docks.

On and after Thursday, the 31st day of May, 1923, copies of the general conditions, specification, schedule of prices, and contract drawing can be obtained from the undersigned on production of a receipt showing that a deposit of £3 has been paid to the Bristol Docks Committee, 19, Queen-square, Bristol, to whom all cheques must be made payable. The deposit of £3 will be returned hereafter to all bona fide tenderers.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Two Electric Cranes," and addressed to the General Manager and Secretary of the Docks Committee, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings, before 10 a.m. on Monday, the 2nd July, 1923.

The Docks Committee do not bind themselves to accept the lowest or any Tender.

THOMAS A. PEACE,
Engineer,
Port of Bristol.

Chief Engineer's Office,
Avonmouth Docks,
23rd May, 1923. 257

State Electricity Commission of Victoria.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 23/77.—ALUMINIUM STEEL-CORED CABLE, 0.0707 sq. in.

CHARGE.—£2 for the first three copies of Tender form, conditions of contract, specification complete. These charges will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. each.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with the Tender.

The specification may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 31st August, 1923.

E. LIDDELOW, Secretary,
State Electricity Commission of Victoria,
Melbourne, Victoria, Australia. 2572

The Bengal and North-Western Railway Company, Limited, and The Rohilkund and Kumaon Railway Company, Limited.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

(a) RAW MATERIAL for 470 C.G. Wagons and 10 Timber Trucks.
(b) 1120 Pairs WHEELS and AXLES for Carriages and Wagons.
(c) 1960 AXLE-BOXES for WAGONS.
(d) 1960 VOLUTE SPRINGS for WAGONS.
(e) 1960 LAMINATED SPRINGS for WAGONS,

as per specifications to be seen at the Company's offices.

Tenders, addressed to the undersigned, and marked "Tender for Wagons," or as the case may be, are to be lodged not later than Noon on Friday, the 29th day of June, 1923.

For specifications (a) and (b) a fee of £1 each and (c), (d) and (e) 10s. each will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
E. A. NEVILLE,
Managing Director.

237, Gresham House,
Old Broad-street, London, E.C. 2.
30/5/1923. 2655

"THE ENGINEER" WANTED.

WANTED, a COPY of "THE ENGINEER" Dated December 28th, 1919.—Address, P5002 The Engineer Office. P5002

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PUBLIC NOTICES

Bombay, Baroda, and Central INDIA RAILWAY.

ASSISTANT ELECTRICAL ENGINEER.

The Directors are prepared to receive APPLICATIONS (by letter only) for APPOINTMENT as ASSISTANT ELECTRICAL ENGINEER in the Electrical Department of the Company in India.

Candidates should be about 24 years of age and single, and must have received a good general and technical education, with experience in electrical engineering on a large railway system or in workshops or power plant. Candidates should give details of their practical experience.

SALARY.—Rs. 450, rising by annual increments of Rs. 50 to Rs. 1100 per calendar month.

TERMS.—A three years' agreement in the first instance and first-class free passage to India and home again on termination of service.

The selected candidate will only be appointed subject to his passing a strict medical examination by the Company's Consulting Physician.

Applications, stating age, whether single, and giving full particulars of experience, accompanied by copies, not originals, of testimonials, should be addressed to the undersigned not later than the 16th June, 1923.

S. O. S. YOUNG,
Secretary.

Offices: 91, Petty France,
Westminster, S.W. 1,
28th May, 1923. 2601

County Council of Surrey.

HIGHWAYS AND BRIDGES DEPARTMENT.

APPLICATIONS are INVITED for the APPOINTMENT of a SECOND ENGINEERING ASSISTANT at a salary of £250 per annum. Candidates must have had experience in Surveying, Levelling, Preparation of Drawings, and Specifications, for Road and Bridge Construction, and shall have passed the examination qualifying for Associate Membership of the Institution of Civil Engineers or hold the Testamur of the Institution of Municipal and County Engineers. Age not to exceed 40.

The appointment will be to the temporary staff, and will not be subject to the provisions of the Local Government Officers Superannuation Act, 1922. Applications, in candidates' own handwriting, accompanied by copies of three recent testimonials, should reach the undersigned by the 16th June, 1923.

W. P. ROBINSON, A.M.Inst.C.E.,
County Surveyor.

County Hall,
Kingston-on-Thames,
30th May, 1923. 2647

SITUATIONS OPEN

WANTED, ASSISTANT MANAGER by Well-known Gear Makers; must have good all-round knowledge of Machine-cut Gearing and previously held similar position. Age about 35 years.—Address, 2487, The Engineer Office. 2487 A

A FIRST-CLASS STEAM TURBINE DESIGNER is REQUIRED by an Engineering Firm of repute. Must be competent to exercise general control over the Steam Turbine Section of the Company's business and preferably have held a similar position with a recognised firm of steam turbine builders. Applications from first-class and experienced men only will be considered, and the firm is prepared to pay a salary commensurate with the qualifications desired. Strict confidence will be observed with all applications submitted, which must state age, details of experience and qualifications, and salary expected.—Address in the first instance, 2618, The Engineer Office. 2618 A

A LARGE ELECTRICAL FIRM has a VACANCY for a thoroughly experienced TEST BED ASSISTANT as right-hand man to Chief; experienced in all classes of Electrical Machinery, including Turbo-alternators and Rotaries, essential. Replies will be treated in confidence, and should include age, experience and salary required.—Address, 2653, The Engineer Office. 2653 A

ADVERTISERS Have VACANCY for ENGINEER as REPRESENTATIVE, who can introduce to them good selling specialities, either manufacturing or agencies. Splendid opening for keen man.—Write full particulars, HARRONS, 148, Curtain-road, London, E.C. 2. P7489 A

ASSISTANT ENGINEER REQUIRED by Old-established Firm of Reinforced Concrete Specialists. Must be a good mathematician and draughtsman and have had experience in the Design of Reinforced Concrete Structures. State age, experience, and salary required.—Address, 2600, The Engineer Office. 2600 A

ASSISTANT MINING ENGINEER REQUIRED for Northern Nigeria, with knowledge of the country and all-round experience.—Write, giving full particulars, enclosing copies of references and stating salary required, to "G. S.," c/o J. W. Vickers and Co., Ltd., 4, Nicholas-lane, E.C. 4. 2596 A

ENGINEER REQUIRED to Take Charge of Oxygen Plant, also small Machine Shop and Supervise men. One with previous experience preferred.—Write, giving full particulars, references, and salary required, to Box 2838, Willing's, 30, King-street, Covent Garden, W.C. 2. 2643 A

ENGINEER (YOUNG), with Some Experience, REQUIRED by established Manufacturers to TRAIN as EXPERT REPRESENTATIVE for their specialised branches. Good personality, energy and initiative essential; excellent prospects to right man. Investment £500-£1000 required.—Address, 2650, The Engineer Office. 2650 A

JAMES DUNLOP AND CO., LTD.—The Directors of this Iron, Steel and Coal Company invite APPLICATIONS for the POSITION of GENERAL MANAGER.—Applications, which will be treated as confidential, are to be addressed to the CHAIRMAN, Mr. E. M. DONALDSON, Blairvaddick, Row, Dumbartonshire. P7468 A

MANUFACTURERS REQUIRE GENTLEMEN with good local connections amongst engineers in each of the following towns:—Bristol, Birmingham, Brighton, Cardiff, Cambridge, Nottingham, Portsmouth, Plymouth, Swansea, Southampton, and Worcester, to introduce their goods as a side line on commission basis.—Address, 2609, The Engineer Office. 2609 A

MECHANICAL ENGINEER.—WANTED for Oil Refinery in the East, an ENGINEER with sound mechanical training and experience, and with some knowledge of Constructional Work. Three years' agreement in first instance with good prospects for permanent senior position. Age 30 to 35.—Apply, with particulars of experience, to Box Q, c.o. Regent Advertising Service, Ltd., 4, London Wall-buildings, London, E.C. 2. P7535 A

RATE FIXER for Switchboard and Cubicle Erection; only first-class men with similar experience considered. State age and salary required.—Address, 2473, The Engineer Office. 2473 A

REPRESENTATIVES REQUIRED by London Oil Refiners; several districts vacant; liberal commission to live men who can secure orders for Lubricants.—Write, giving full particulars, giving territory, turnover, &c., to Box 1785, Sell's Advertising Offices, Fleet-street, E.C. 4. 2649 A

WATERWORKS ENGINEERS' ASSISTANT REQUIRED, age about 25, for large town in South of England; must be a capable and energetic man, with good Waterworks Experience.—Apply, stating experience, &c., qualifications and salary required, together with testimonials (if any) and when free to take up position, if necessary, to Z. E. W. C., c.o. Samuel Deacon and Co., Ltd., 7, Leadenhall-street, E.C. 3. 2635 A

WANTED, CRANE DRAUGHTSMAN, Accustomed to all types of Steam and Electric Cranes. Permanent position and good salary for suitable man; Leeds district. State age, experience and salary required.—Address, 2645, The Engineer Office. 2645 A

WANTED, First-class CRANE DRAUGHTSMAN, well up in Steam and Electric Cranes; no one who has not specialised in this class of work need apply. Permanent position for suitable man. State experience and wages required.—SAMUEL BUTLER and CO., Ltd., Granscroft Works, Stanningley, Leeds. 2625 A

CHIEF DRAUGHTSMAN for Steam Wagon and Traction Work. Must be good designer of proved ability. A detail man with good control of men essential. None but experienced men need apply. Give full particulars and salary expected.—Address, 2623, The Engineer Office. 2623 A

DETAILING DRAUGHTSMAN REQUIRED by Constructional Engineers in London.—Address, stating experience, age and salary required, P7540, The Engineer Office. P7540 A

DRAUGHTSMAN, AERONAUTICAL, SENIOR, with thorough knowledge of Stressing Complete Aircraft in accordance with A.M. requirements. State full particulars, age, experience, salary required, and when disengaged.—WESTLAND AIRCRAFT WORKS, Yeovil. 2617 A

DRAUGHTSMAN WANTED, Accustomed to Colliery Screening Plants, Headgears and Structures.—State experience, references, when at liberty and salary to G. R. TURNER, Ltd., Langley Mill, Notts. 2523 A

DRAUGHTSMAN WANTED for Midlands, Experienced in the Design of Automobile Engines and Chassis. State age, experience, and salary required.—Address, 2620, The Engineer Office. 2620 A

DRAUGHTSMEN WANTED, Glasgow District, accustomed to Water-tube Boilers. State age, experience, and salary required.—Address, 2602, The Engineer Office. 2602 A

FIRST-CLASS DRAUGHTSMEN WANTED, Preferably with a knowledge of Lifting, Transporting and Conveying Machinery. State age and salary required.—Address, 2471, The Engineer Office. 2471 A

FRENCH-SPEAKING MECHANICAL DRAUGHTSMAN WANTED for position in Canada. Knowledge of Engineering Mathematics necessary as well as skill in Drawing.—Address, with qualification particulars, 2551, The Engineer Office. 2551 A

REQUIRED for a Period of About Six Months, a Competent CONSTRUCTIONAL STEEL DRAUGHTSMAN and DESIGNER, having experience in the Design of Light Steel Work.—Address, 2631, The Engineer Office. 2631 A

FOREMAN MOULDER REQUIRED for Sand and Loam Work, castings up to 15 tons of jobbing variety. Must be able to set piecework rates. State age, salary required, and enclose copies of references.—Address, 2629, The Engineer Office. 2629 A

FOREMAN FITTER REQUIRED for Hydraulic and General Engineering Works. Must be able to set piecework rates. State age, salary required, and enclose copies of references.—Address, 2630, The Engineer Office. 2630 A

WANTED, Highly Skilled TOOLMAKER MECHANIC, expert at Jigs, Cutter Heads, Gauges, Hardening, Grinding, &c., and rigging up machines for mass production of parts with great accuracy by unskilled labour, to act as FOREMAN MANAGER of New Small Works to employ about 30 hands, being erected near Brighton. £4 per week plus 10 per cent. profits. Must have had full rate as toolmaker and been charge hand in a modern shop, also possess testimonials as to his skill and capacity of getting output. Preference given to a keen young man not afraid of hard work, out for success first and last, able to keep expenses down and deal with all difficulties, demands and extortions of governmental bodies, and satisfy the officials. Knowledge of electricity and stove enamelling helpful, but not essential.—Address, P7522, The Engineer Office. P7522 A

MECHANIC WANTED for the Far East. First-class tradesman with up-to-date experience in Tin Can Making Machinery; must be capable of Taking Charge and be responsible for keeping machinery and dies in best possible condition. Single man preferred.—Apply by letter, stating age, full particulars and experience and where apprenticeship was served, Box 1716, Sells' Advertising Offices, Fleet-street, E.C. 4. 2469 A

SITUATIONS WANTED

WANTED, Cardiff, Swansea, &c., Any POSITION of TRUST, charge of plant, assistant to works engineer, inspection of boilers, engines, steel structures during construction, &c. Indentured six years, technical, 1st Class B. of T. Certificate, late assistant to Chief Engineer, War Office, engineer-lieutenant Navy, present surveyor to leading insurance co.; salary not first consideration. Age 34 years, married.—Address, P7514, The Engineer Office. P7514 B

WANTED, POSITION as FOUNDRY MANAGER by expert Foundryman, with up-to-date methods of pipe making, locomotive, and general engineering castings.—Address, P7494, The Engineer Office. P7494 B

ADVERTISER (24), 4 Years' Engineering College, good general education, DESIRES START, any capacity.—V. E. W., 34, Hart-road, Dorking. P7537 B

A. M.I.A.E., M.I.P.E., Holding Position as Production Manager, DESIRES CHANGE. Accustomed to full control of works, buying, costing, &c., and organising for economical production. Experience covers marine engineering, aircraft, and motor trades. Age 34.—Address, P7521, The Engineer Office. P7521 B

APPOINTMENT WANTED.—CIVIL ENGINEER, with excellent experience at home and abroad, DESIRES responsible POSITION with established firm of engineers, contractors or builders, where his technical and administrative ability can be of value. Some capital available.—Address, P7474, The Engineer Office. P7474 B

ASSOC. M. INST. C.E., Age 37, 4 Years' Railroad construction, Argentina, fluent Spanish, SEEKS POST, home or abroad.—Address, P7515, The Engineer Office. P7515 B

ENGINEER, A.M.I.C.E., M.I.M.E., of Proved ability, OFFERS his SERVICES in any suitable capacity. Exceptional experience in the lay-out, design, construction, installation, maintenance, repairs, and running of all classes of modern factory and works plant, mills, machinery, equipment, and buildings; also in the purchase, inspection, and testing of the above.

Advertiser has occupied responsible executive positions during the last ten years, is 35 years of age, possesses energy, initiative, business acumen, and sound organising ability. Thoroughly accustomed to efficient control of engineering workshops, labour, and staff.

Inquiries invited.

Address, P7505, The Engineer Office. P7505 B

ENGINEER, M.I.M.E., M.I.S.E., SEEKS ENGAGEMENT on Preparation of Schemes, Erection of Works and Plant. Used to control on large industrial works.—Address, P7511, The Engineer Office. P7511 B

SITUATIONS WANTED (continued)

ENGINEER, with Considerable Administrative, technical and commercial experience, occupying important post, DESIRES CHANGE; capable handling big propositions and with intimate knowledge Western Europe. Prepared consider offers from firms of standing. Minimum salary £750.—Address, P7532, The Engineer Office. P7532 B

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For continuation of Small Advertisements see page 3

MAY.

The Helicopter Competition.

DURING the month the Air Ministry published the requirements and conditions to be observed in connection with its offer of £50,000 in prizes for machines of the helicopter type. The competition is to be open to all nationalities, and entries will be received up to the end of next April. The tests to be completed by the machines are in four sections. In the first, the machine, carrying pilot, one hour's fuel supply and 150 lb. of military load, and in a wind not exceeding 20 miles an hour, will be required to ascend vertically from rest on the ground to a height of 2000ft. and to descend and land again without damage. For the second test, the machine similarly loaded and in a similar wind is to ascend to 2000ft. and remain at that height for half an hour over a ground area indicated by the judges. The third test is to consist of a flight at 2000ft. over a prescribed closed circuit of 20 miles at an air speed of not less than 60 miles an hour. For the fourth test, the machine is to be manœuvred in the air over a given point on the ground, to descend from a height of 500ft. with the engine shut off and to alight without damage within a circle of 100ft. radius struck from the given point as centre. For the completion of the first test a prize of £5000 will be awarded. For the first and second, first and third, and first and fourth, further sums of £15,000, £20,000 and £10,000 respectively will be granted. A special clause in the conditions prohibits any award of a prize "in respect of the helicopter now being constructed by Louis Brennan, Esq., C.B., for and on behalf of the Air Council." Should one or more of the prizes not be awarded, they will be re-offered for competition within a further period of one year subsequent to the announcement of the results of the original tests.

The Boilermakers' Dispute.

WHEN the Engineering and Shipbuilding Trades Federation signed the overtime, night-shift and holiday work agreement on March 22nd, three of its constituent unions, the Boilermakers', the Joiners' and the Plumbers', intimated that as they had refused to take part in the ballot which led to the acceptance of the agreement, they declined to be bound by it. Notices against the members of the three unions were accordingly posted by the employers on April 23rd. The operation of the notices against the joiners and plumbers was subsequently postponed for a week, namely, until May 7th, in order to give them time to reconsider their position. During that week the men continued at work "under protest," but in accordance with the terms of the agreement. Before the notices expired, however, their representatives intimated that they had decided to fall into line with the general body of the Federated Unions and accept the agreement. Meanwhile, the Boilermakers' Union persisted in its recalcitrant attitude, and as it refused to allow its members to continue at work "under protest" while their opinion was being taken by a ballot, no extension of the notices was granted in their case, and the men where not already on strike found themselves locked out on the first of the month. The result of the ballot has not so far been officially disclosed, but, it is understood, that it showed a small majority against accepting the agreement. The men have since remained idle. In consequence of the attitude adopted by this union, the Federation towards the middle of the month expelled it from its membership of that body. The boilermakers' representatives replied to that action by declaring that their union had ceased to be a member of the Federation several weeks previously, on the date, in fact, when it intimated its refusal to take part in the original ballot on the agreement.

Railway Accident Inquiries in 1922.

THE last of the Ministry of Transport reports on those railway accidents during the year 1922 was issued during the month. In the whole period there were twenty-seven such inquiries, which was about the average annual number. Of these, fifteen related to collisions, two to buffer stop collisions, five to derailments, and five to locomotive failures. Of the fifteen collisions, six were cases where drivers ran past signals at "danger" in clear weather, and in two others when fog prevailed. Two were due to irregular block working by signalmen; one to wagons being overlooked by signalman; one to the route for a train being hurriedly changed and the signalman failing to notice that the new direction was fouled; one was a collision between the two portions of a goods train that became divided owing to a coupling failing; and one arose because some wagons and a brake van had not been properly secured, and they ran forward and came into collision with their engine. The two buffer stop collisions were due to errors of judgment by drivers. Three of the five derailments were consequent on defective permanent way, and one was due to inefficient facing point equipment. The remaining derailment was considered mainly to be due to four-wheeled vehicles being placed in front of heavier stock. Three of the five locomotive failures were cases of broken coupling-rods, one of a tender step becoming loose and falling off whilst running, and one of a broken crank axle. No recommendations were made in the reports on six of the accidents. In seven cases it was observed that automatic train control would have prevented the mishap. Track circuit was asked for in only one instance, and in two it was recommended that signalmen should be forbidden to change the route of a train after it had been accepted. Recommendations as to locomotive repairs and the material used in the construction of locomotives were made in four cases.

Importance of Fairs.

THE success of the Paris Fair during the month provided further evidence of the growing popularity of these trade manifestations, for since there were close upon 5000 exhibitors, representing nearly every branch of national industry, the attraction it offered to the public was greater than ever. The value of "fairs" as a means of bringing them into direct contact with customers is generally admitted by French manufacturers, provided they are held under suitable conditions, and so keen was the competition amongst industrial and commercial towns to secure the support of the trade that it was found necessary to limit the number of "fairs" to the one in Paris, devoted exclusively to national industries, to the two international fairs at Lyons and to the fair at Bordeaux, which is largely concerned with the maritime and colonial interests. For the same reason, some restriction had to be placed on the number of exhibitions of machinery that were threatened to be organised in every agricultural centre in the country. Three such provincial fairs are now officially recognised, but others are held, and the manufacturer who participates in all of them finds the financial strain very severe. Experience, however, has taught firms just where to exhibit their own particular products, and while it might be supposed that some of the municipalities which organise "agricultural weeks" and similar gatherings would find dwindling support, they show no desire to relinquish their exhibitions, which they seek to prove, indeed, are indispensable to the country's commercial activity. In addition to this long list of fairs and shows, there is an international exhibition at Le Mans and another at Thann, in Alsace. This multiplicity of machinery exhibitions proves, at any rate, the interest being taken by the French in everything relating to labour economy at a time when wages are three times what they were before the war.

The Kelvin Lecture.

DR. J. A. FLEMING'S fourteenth Kelvin Lecture on "Problems in Telephony, Solved and Unsolved," delivered at the headquarters of the Institution of Electrical Engineers on the 10th of the month, was of very great interest. Although remarkable progress has been made in line and radio telephony, there is still room for investigation. In wireless work the three principal unsolved problems to which Dr. Fleming referred are those associated with "atmospherics," "blind spots," and "fading," which at present constitute the principal troubles met with by wireless experimenters. Patent Office records show that many schemes have been devised to overcome atmospherics, but none of them are completely successful. There are, of course, other forms of interference which sometimes prove troublesome to wireless workers, such as that arising from electrical machinery or traction lines in the neighbourhood of receiving apparatus, and also interference from powerful spark and arc stations. The causes of "fading" and "blind spots" are at present not at all well understood, and it is very gratifying to find that the Radio Research Board is giving attention to these matters. Perhaps the most praiseworthy part of Dr. Fleming's lecture was his appeal for research. There is no doubt that in America very great strides are being made in wireless work, as the result of the scale on which research work is carried out, and we must not relax our efforts in this country.

Motor Ship Progress.

ELSEWHERE in our issue to-day we give an account of the motor cargo ship Dalgoma, which is the first British-built vessel to be equipped with two-cycle Sulzer type Diesel engines working in conjunction with electrically driven turbo-blowers. Similar machinery is in course of construction at the Fairfield yards for the new Union Steamship passenger liner, and very satisfactory progress is being made. During the month it was announced that John Brown and Co., Limited, of Clydebank, are also to build the Sulzer type of engine, and it may be expected that units of large size will eventually be built at Clydebank. Considerable interest attaches to the Scott-Still combined oil and steam engine, which is being constructed for a Holt Line vessel at Scotts, of Greenock. We understand that progress with this machinery is so far advanced that a preliminary run has already been made with the first engine, and that the complete installation should be ready in the autumn. At the North British Diesel Engine Works at Whiteinch a large-power two-cycle double-acting engine, which embodies entirely new principles, is in course of erection. Not less interesting is the four-cycle double-acting engine which has been experimentally evolved by Burmeister and Wain, of Copenhagen, and will be developed by Harland and Wolff. Camellaird-Fullagar opposed-piston type engines are approaching completion, both at John Brown's Clydebank yard, and also at the works of David Rowan and Co., Limited, where the first set of single-screw machinery of this type is being built. During the month some welcome orders have been received by Harland and Wolff for both the long-stroke and the standard type of engine, and this will mean additional work for the firm's Glasgow Diesel engine works and for the new foundry in Helen-street, Govan.

The Caledonian Railway Amalgamation Terms.

THE Caledonian Railway Company was scheduled in the Railways Act to be incorporated into the North-Western, Midland and West Scottish group, but it failed by December 31st last to agree as to the terms under which incorporation was to be effected. It was, therefore, left to the Railway Amalgamation Tribunal to prepare a scheme, and the case was heard during the first week of the month. On the 10th the Tribunal gave its award, which, whilst much below what the Caledonian proprietors expected, was slightly higher than what they were offered. The point of difference lay mainly in the preferred converted ordinary stock, which for every £100 is to receive £50 of 4 per cent. preference stock and £13 6s. 8d. ordinary stock of the amalgamated company. The argument of the Caledonian proprietors is that, whilst the 4 per cent. will ensure 2 per cent. the £13 6s. 8d. will not give the other 1 per cent. to make the 3 per cent. hitherto paid, unless the amalgamated company pays at least 7½ per cent. on its ordinary stock. They allege, further, that the terms under which the other constituent companies have come in have proceeded generally on an assumed rate of 7 per cent. on the amalgamated ordinary stock. The deferred converted ordinary stock was offered £8 in the ordinary stock of the amalgamated company. The Tribunal has increased this figure to £10, but the Caledonian directors consider that the present position and prospects of the company are under-rated. In announcing in our "Railway Matters" column on the 18th, the above judgment, we observed that the decision of the Tribunal was final, and that there is no appeal. Actually, this hardly is so, as under Sub-section (7) of Sec. 9 of the Railways Act the Court of Appeal or, as in this case, the Court of Session, may hear any question of law. Moreover, the Tribunal has yet to prepare a complete scheme, and to this the Caledonian Company can lodge objections, which, under Sec. 9 of the Act, would have to be investigated at such an inquiry "as appear necessary to the Amalgamation Tribunal."

Miners' Wages.

THERE was some fear that the miners' objection to the national wages agreement, which they signed nearly two years ago, would lead to a serious decision at the Blackpool Conference, which opened yesterday, but the danger of a strike was averted by a suggestion made by the Prime Minister that the Labour Party should give up one of the days allotted to it and allow the subject of the minimum wage to be debated in the House of Commons. This suggestion was made on Tuesday last, the 29th of the month, to a deputation which waited upon Mr. Baldwin to ask for facilities for a discussion on Mr. Adamson's Bill, which provides that the minimum wage shall apply to surface workers as well as colliers, and, notably, that it shall be calculated on the basis of the cost of living. The Prime Minister's suggestion was well received, and will probably be acted on.

The Cordeaux and Avon Reservoirs for Sydney Water Supply.

Two large masonry dams, known respectively by the names of the rivers they will regulate, the Cordeaux and Avon, are at present under construction within the Nepean Watershed, the water supply catchment area for the City of Sydney in the State of New South Wales, Australia. The reservoirs formed by their construction will increase the existing storage upon that area from 20,743 million gallons now impounded in the Cataract Reservoir to a total of 84,353 million gallons, while the construction of a fourth reservoir at Lupton on the Nepean River itself, to impound a further 11,600 million gallons, is contemplated. The total storage capacity of the four reservoirs will be 96,153 million gallons.

The extent of country within the Nepean River Watershed which is utilised as catchment area for water supply, and which was selected for the purpose over fifty years ago, is 347 square miles in extent. Existing works—the Cataract Dam—fully control 50 square miles, the works under construction—the Cordeaux and Avon Dams—will control an additional 90 square miles, and those in contemplation—the Lupton Dam—will control to a lesser degree a further 116 square miles, leaving the remaining 91 square miles partly controlled as at present by diversion weirs up to a limit of 150 million gallons per day river discharge. The whole of these works when completed will probably represent the limit of economical control of this source at all events for many years to come.

The present average daily consumption of the City of Sydney is 50 million gallons per day—a figure which it is estimated will increase to 80 million gallons per day by the year 1930. For the purpose of meeting these demands the storages enumerated, which are situated upon a comparatively well watered catchment may appear unduly large in comparison withthose that have sufficed elsewhere; but a study of the meteorological data available over a series of years and such river gaugings as are available for a lesser period, combined with the physical characteristics of the catchments, shows the necessity for such storage. The average annual rainfall upon the Nepean catchment area is 48in. The Cataract, Cordeaux and Avon watersheds are situated on that portion of the area where the precipitation is greatest and on which the average rainfall approximates to 55in. The whole catchment area is situated between the 34th and 35th parallels of latitude and lies approximately upon an east and west line marking the southern limit of the northern summer monsoonal rainfall control and the northern limit of the southern winter or Antarctic control. It thus arises that there is no well defined wet or rainy season and beneficial falls may occur during practically any month of the year. This feature, moreover, would appear to affect the meteorological "reliability" of the rainfall from year to year, and the value of the catchment is on this account less than that of other areas further south subject only to the Antarctic control which record a lesser average annual figure. The rainfall records available from stations actually on the catchment extend back to 1871 or fifty-one years, and those of Sydney, which may be correlated, to 1840, or eighty-two years, and show series of successive years in which the rainfall was markedly below the average. It is the occurrence, and possible recurrence of such periods, coupled with a fairly high evaporation, which calls for large storages. For instance, for the ten years 1901 to 1910 the respective annual average rainfalls of all stations on the catchment area were 36.4, 32.3, 40.1, 54.1, 32.7, 30.3, 28.0, 38.9, 33.54, 43.4—ten successive years—nine of which were below the average annual figure.

The Nepean River watershed from a topographical standpoint is singularly favourable to construction of large works of storage at moderate cost. The streams are young geologically and there are narrow gorges, suitable for dam sites with solid rock foundations at a shallow depth, at points where the moderate fall in the streams gives good storage capacity for the reservoirs formed. The area, which is uninhabited except for a few farms at the extreme southerly corner, carries little depth of soil and a poor forest of stunted eucalyptus with occasional reedy swamps. The water is a soft first-class potable water, and apart from the purification effected by storage and subsequent screening, requires no further treatment before passing into consumption.

The illustration—Fig. 1—is a plan of the Nepean River catchment areas showing the positions of the rain-gauging stations, isohyetals of average rainfall and the positions of the Cataract, Cordeaux and Avon reservoirs and that proposed on the Nepean. Fig. 2 gives cross sections of the rivers at the sites of these several storages; while Fig. 3 shows typical cross sections of the Avon dam.

The following table gives particulars of the several storages on the Nepean Catchment area constructed, under construction, or proposed:—

Name.	Catchment area, square miles.	Storage capacity, million gallons.	Maximum depth of water, feet.	Safe draught, million gallons per day.	Cost, actual or estimated.
Cataract, completed 1906	50	20,743	150	29	£ 383,459
Cordeaux, under construction ..	35	20,610	170	17	810,000
Avon, under construction	55	43,200	206	33	956,000
Lupton, proposed ..	116	11,600	200	19	—
		96,153		98	

The geological formation of the area is of particular interest as bearing upon the form of construction adopted for the dams. It consists of a sedimentary rock of the Triassic period and of the Wianmatta, Hawkesbury and Narrabeen stages commonly known as the Hawkesbury sandstone. It occurs in extremely uniform horizontal beds 2ft. to 20ft. in depth, without sign of flaw or fracture, interspersed by narrow bands of shales, grits and conglomerates—see Supplement and Fig. 4. The stone is readily quarried from these ledges with slow-burning explosives, such as gunpowder, and with explosives alone may be cut into rough rectangular blocks of almost any practicable shape or size. It may be further divided inexpensively into smaller sizes and dressed by the use of hand tools or machinery. It has a pleasing appearance and is largely utilised as a building stone in the city of Sydney, the cost of dimension stone in position being little more than twice that of brickwork. The mean weight of the Hawkesbury sandstone has been determined at 140 lb. per cubic foot. Compressive tests upon 6in. cubes show an ultimate strength of from 180 to 400 tons per square foot, a mean value being 277 tons per square foot.

The Hawkesbury sandstone, lending itself to quarrying in large rectangular blocks as described, points to the use in dam construction of a Cyclopean concrete or masonry containing as large a proportion of such blocks as can be economically used, having regard, on the one hand, to the cost of quarrying, squaring and transporting blocks, and, on the other, to the cost of cement and concrete. It would be possible to dress the sandstone blocks to accurate dimensions and bed and joint them in cement mortar and so produce a very fine class of random ashlar masonry; but to do so, keeping the quantity of cement used within reasonable limits, would involve a very large amount of highly paid labour on the stone blocks, a considerable reduction in their size, and a great expenditure of time to cut the blocks to fit. It is thus found more economical to use the stone in irregular, roughly rectangular blocks bedded on and packed with sandstone concrete, cement mortar being used only where necessary. Provided care is exercised, excellent concrete can be made with Hawkesbury sandstone crushed to a 2½in. gauge, while by further crushing a good sand is produced. Concrete made from these materials has been under observation and test for very many years, and a breaking load of 120 tons per square foot on 6in. cubes of a 1 : 2½ : 5 mixture six months' old is a fair average of observations.

The cement used is manufactured in New South Wales to the Public Works Department's specification, which is generally similar to the British standard specification, though differing somewhat in detail. For instance, (*a*) different tests for degree of fineness are specified; (*b*) the Department's specification provides for machine methods in filling the moulds, as compared with the hand methods of the British standard; and (*c*) it omits the tensile test of neat cement at twenty-eight days,

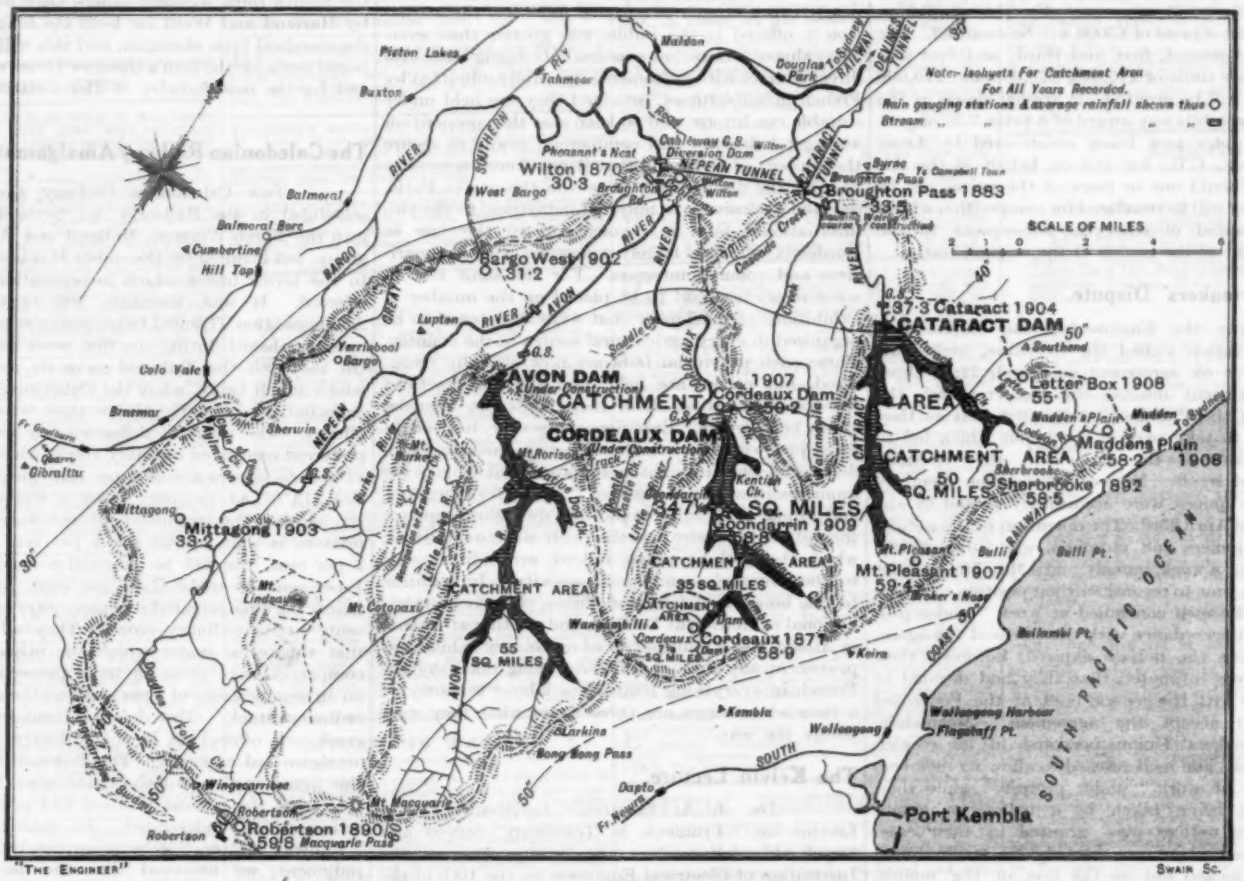


FIG. 1—MAP SHOWING THE NEPEAN RIVER CATCHMENT AREAS.

while the Deval hot water bath is retained.

River sand, denuded from the Hawkesbury sandstone and graded, is used as a standard in the Department's laboratories, and is also used when readily available for concrete in such works as those described. Sand, machine crushed from the rock, screened and washed, is also used, but tests show that sand direct from the crushers gives results, especially on the older tests, so little inferior to washed sand as to make washing unnecessary. The practice, then, is to use the "run of the crusher," adding such quantity of sand as frequent volumetric examination of the material shows to be necessary. It is with regard to the proper proportion of sand that care is necessary in the use of the Hawkesbury sandstone for concrete.

It is possible, if iron rammers or spades are used excessively for ramming such sandstone concrete, to break or abrade the stone, thus increasing the quantity of sand in proportion to the cement, and for this reason concrete made with hard basaltic stone, instead of sandstone, is used for the upstream face of the dams and for any special portions of the work where a great deal of ramming is indicated and where a fine and highly durable surface is called for. For this reason, while sandstone concrete is used in the dams for bedding and packing between the large blocks of sandstone and also on the downstream face of the dam—which is not utilised as a spillway—basaltic stone concrete is used for a thickness of 2ft. more or less on the upstream face of the dam and in all positions exposed to the action of running water. This facing of basaltic concrete on the upstream face of the dam is in no way separate from the structure itself, the greatest care being taken that it should merge with and set together with the sandstone concrete used in the bulk of the structure. In order to attain this object the Cyclopean concrete forming the bulk of the dam is built most irregularly, the sandstone blocks being kept back from the upstream face line of the dam for a distance of from 4ft. to 6ft., and the concrete between these blocks and the forms outlining the upstream face of the dam is laid with sandstone and basaltic concrete simultaneously, the latter being placed next the timber facing forms, as near as may be to the required thickness of 2ft., and the whole being then rammed together. Vertical sections of this work, dressed down after the concrete is thoroughly set, show an irregular line of blending between the sandstone and basaltic concrete, and, judging from the results obtained, the union between the two is so satisfactory and complete that no apprehension whatever is entertained as to any line of demarcation or cleavage developing between the two classes of concrete. The engravings illustrating the construction of the Cordeaux Dam, which are given in our Supplement, make the general method of construction abundantly clear.

Special attention has been paid to the design and lay-out of the metal crushing and concrete mixing plant at the Avon Reservoir, which is illustrated in the Supplement and on page 572. The crushing plant comprises two 20in. by 12in. Jacques roll jaw crushers, belt driven from 35 horse-power pipe-ventilated Crompton motors, and one pulverising mill with a capacity of 7 tons per hour, driven by a B.G.E. 30 horse-power motor of the open protected type. The crushed stone and sand are elevated to a rotary screen at the top of the mixer house by means of an endless rubber belt and buckets with a capacity of 30 tons per hour. From the screen it is discharged as required to the various sand and stone bins allotted to each mixer. The concrete mixture is accurately proportioned by measuring bins with automatic cut-off and discharge, the sand and cement being measured by weight, and the stone being gauged in the batch hoppers of the mixers. The concrete mixing plant comprises three "Multimix" drum type batch mixers, each with a capacity of 40 cubic feet and an output of thirty batches per hour, provided with fixed batch hoppers and automatic water tanks. Each mixer is driven by a 25 horse-power Crompton totally enclosed pipe-ventilated motor. From the mixers the concrete is discharged to concrete skips, specially designed to facilitate the distribution of the concrete in varying quantities. The skips have each a capacity of 3 cubic yards, and their special feature is that a portion or the whole contents of the skip may be discharged at will as is required at each part of the work.

It will be seen from the accompanying diagrams of the dams—Fig. 2—that the Cordeaux Dam is being constructed on a radius of 2870ft. in plan, and the Avon Dam on a radius of 1200ft. in plan. In order to provide against cracks arising from contraction and expansion in the structure or for slight unequal settlement due to the varying mass and weight of the dam on various portions of the section, radial joints are provided in the structure at intervals. These joints, which are clearly indicated in one of the engravings in the Supplement are constructed by completing a segment of the dam against timber forms and building, the adjoining section against the stripped concrete without any bonding other than is afforded by a step back in the radial joint in plan. Provision is made on the upstream side of the dam for a covering joint to minimise leakage.

While the sandstones and Narrabeen shales underlying the site of these dams are remarkably dry, a small amount of water is met in successive beds and a complete network of bores has been sunk over the whole of the foundations by means of diamond drills and cement grout injected therein under pressure. In addition to this precaution, a certain number of holes have been tubed and led up into drainage galleries, but experience at the Cataract Dam, which has been completed for some years, does not lead to any water flow of importance through the surrounding and underlying strata being apprehended.

In order to reduce, as far as possible, the pressure on the outlet valves, arrangements have been made to draw off water from the reservoirs at two levels. The upper draw-offs will consist of two 3ft. 6in. diameter pipes each fitted with needle valves 2ft. 6in. in diameter, and will be situated between 90ft. and 100ft. below top water level. The lower draw-offs, which are also to be utilised for passing the stream flow during the construction of the work, consist of two 3ft. 6in. diameter pipes fitted with 3ft. diameter needle valves at the level of the river bed. The

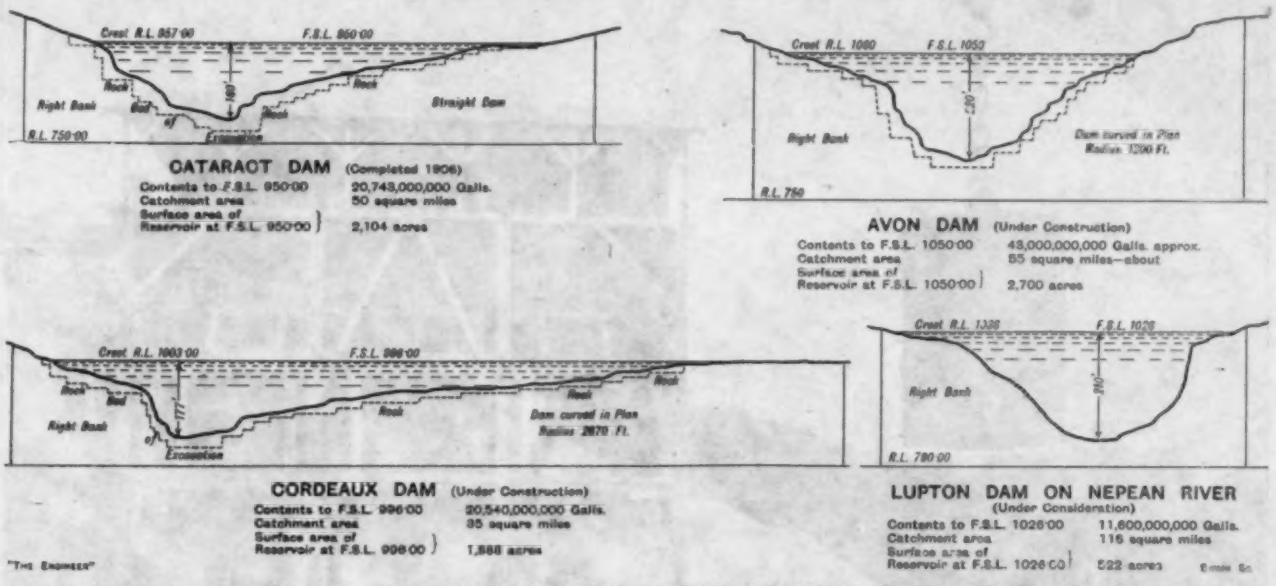


FIG. 2—CROSS SECTIONS OF THE RIVERS CATARACT, AVON, CORDEAUX AND NEPEAN, AT THE SITES OF THE DAMS

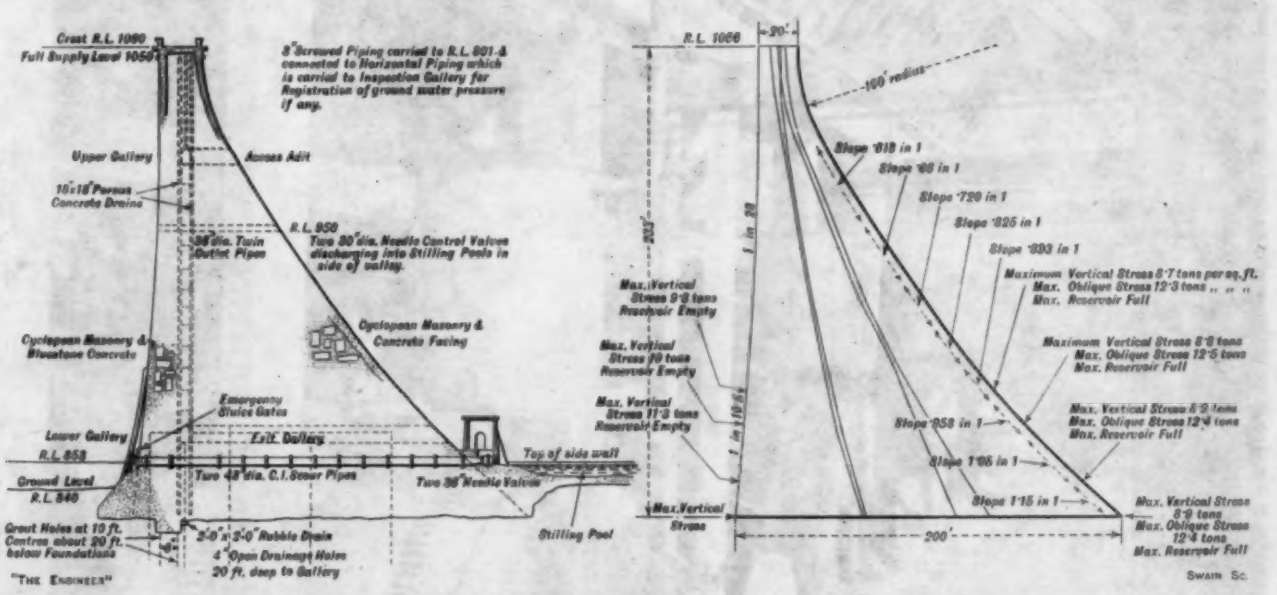
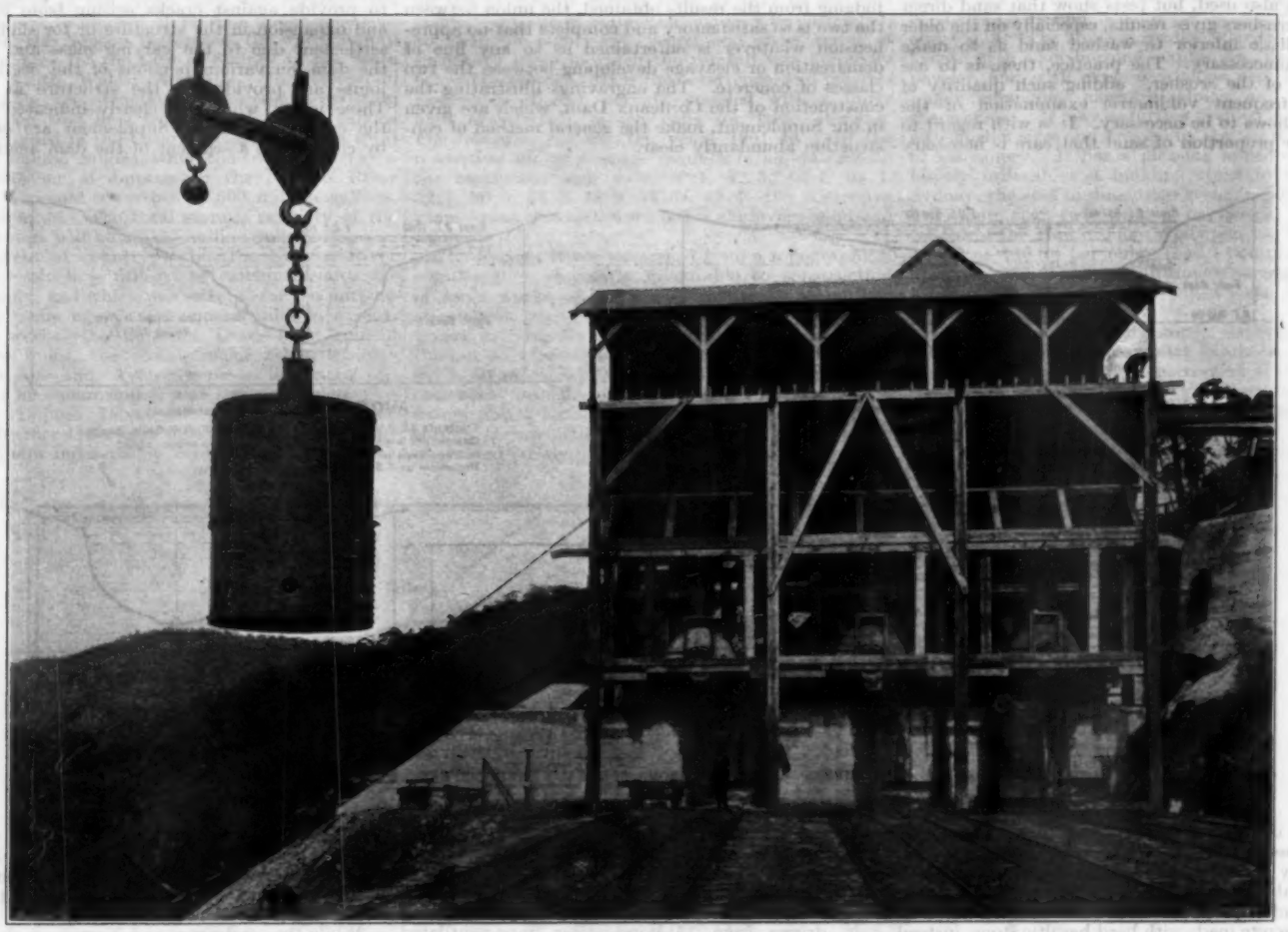

Crest R.L. 1090
Full Supply Level 1050
8" Screwed Piping carried to R.L. 801·5 connected to Horizontal Piping which is carried to Inspection Gallery for Registration of ground water pressure if any.
Upper Gallery
Access Adit
18"×18" Porous Concrete Drains
R.L. 950
36" dia. Twin Outlet Pipes
Two 30" dia. Needle Control Valves discharging into Stilling Pools in side of valley.
Cyclopean Masonry & Bluestone Concrete
Cyclopean Masonry & Concrete Facing
Emergency Sluice Gates
Lower Gallery
R.L. 853
Exit Gallery
Top of side wall
Two 48" dia. C.I. Sewer Pipes
Two 36" Needle Valves
Ground Level R.L. 840
Grout Holes at 10 ft. Centres about 20 ft. below Foundations
2'-0" x 2'-0" Rubble Drain
4" Open Drainage Holes 20 ft. deep to Gallery
Stilling Pool
"THE ENGINEER"
R.L. 1066
20'
100' radius
Slope ·618 in 1
Slope ·69 in 1
Slope ·720 in 1
Slope ·825 in 1
Slope ·893 in 1
Maximum Vertical Stress 8·7 tons per sq. ft.
Max. Oblique Stress 12·3 tons " " "
Max. Reservoir Full
203'
1 in 82
Max. Vertical Stress 9·3 tons Reservoir Empty
Max. Vertical Stress 10 tons Reservoir Empty
Max. Vertical Stress 11·3 tons Reservoir Empty
1 in 10·6
Maximum Vertical Stress 8·8 tons
Max. Oblique Stress 12·5 tons
Max. Reservoir Full
Slope ·958 in 1
Max. Vertical Stress 8·2 tons
Max. Oblique Stress 12·4 tons
Max. Reservoir Full
Slope 1·06 in 1
Slope 1·15 in 1
Max. Vertical Stress
Max. Vertical Stress 8·9 tons
Max. Oblique Stress 12·4 tons
Max. Reservoir Full
200'
Swain Sc.

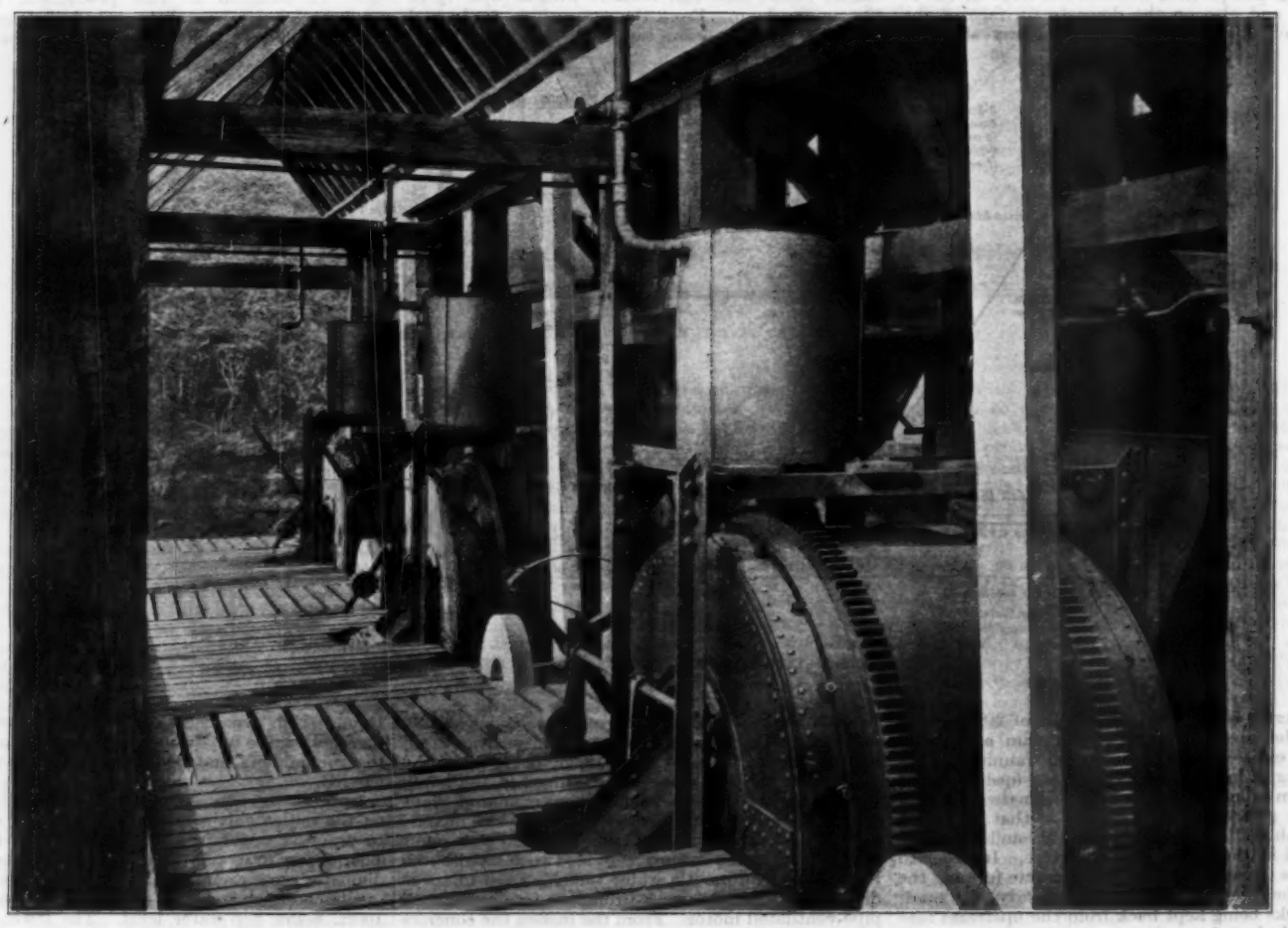
FIG. 3—TYPICAL CROSS SECTIONS OF THE AVON DAM

SYDNEY WATER SUPPLY—CONCRETE PLANT FOR THE AVON DAM

MR. E. M. DE BURGH, M. INST. C.E., SYDNEY, N.S.W., ENGINEER



THE CONCRETE MIXING HOUSE—SHOWING SPECIALLY DESIGNED SKIP FOR PLACING CONCRETE



INTERIOR OF CONCRETE MIXING HOUSE

upper pair of valves will control the greater volume of water in the reservoir, and no arrangement is provided for drawing the surface water only, seeing that there is ample aeration during the passage of water down the river to the points of diversion into the Sydney water supply system.

With regard to transport to the site of the works, the Cordeaux Dam is situated 13 miles from the Main Southern Railway, close to which the deep gorge of the Nepean River intervenes. The principal material to be hauled consists of cement and basaltic metal for use in a portion of the concrete. Three miles of aerial ropeway, steam operated, have been constructed from the main line across the Nepean Gorge, whence a 2ft. gauge railway, operated by steam locomotives, completes the connection to the dam site. In the case of the Avon Dam a first-class road has been constructed over the distance of some 6 miles separating the dam from the Main Southern Railway, and all material is hauled over this road by petrol-driven motor lorries.

The plant and equipment at the two works is very similar, the lay-out being varied to suit each site. The plant at both is electrically operated, the current being obtained from the State Power Station at Port Kembla on the south coast by transmission line, 14 miles in length, to Cordeaux with a further 5-mile extension to Avon. Current is transmitted at 33,000 volts three-phase 50-cycles stepped down to 415 volts for distribution at the works.

Lists of the principal items of plant in operation at Cordeaux and Avon Dams are as follows :—

List of Principal Items of Plant in Operation at the Cordeaux Dam.

Sub-station transformers : Four single-phase General Electric transformers (three on line and one spare), each 210 kilovolt-ampères, ratio 33,000/415 volts.

Cableways : Two Lidgerwood cableways, span 1320ft., capacity 15 tons. Maximum traversing speed 1300ft. per minute, maximum lifting speed 260ft. per minute. Fitted with shock-absorbing fall-carriers and dumping gear controlled by driver. Main cables 2¼in. locked strand steel rope on moving head and tail towers, each 80ft. high. Driving motor 200 horse-power, with automatic accelerating controller remote controlled. The cableway towers are moved by two 32 horse-power electric winches.

Air compressors : Two 12in. by 14in. Ingersoll-Rand, driven by 75 horse-power motors, and one 12in. by 12in. machine, driven by a 50 horse-power motor, compressing to 80 lb. per square inch.

Locomotive cranes : Two to lift 15 tons at 15ft. radius and 7½ tons at 30ft. at 50ft. per minute, and traverse with full load up a grade of 1 in 80 at 3 miles per hour, the driving motors being of 50 horse-power.

Derrick cranes : Two to lift 15 tons at 35ft. and 10 tons at 50ft. radius at speeds of 25ft. and 50ft. per minute respectively, driven by 45 horse-power motors. Two derricks to lift 5 tons at 50ft. radius at 30ft. per minute, driven by 30 horse-power motors.

Crushers : Two 20in. by 10in. Hadfield jaw crushers, driven by 25 horse-power motors. One John pulveriser, driven by a 25 horse-power motor.

Elevator : One double-chain bucket elevator, 78ft. centre to centre of sprockets, capacity at speed of 130ft. per minute 30 tons per hour.

Concrete mixers : Two Ransome ¾ cubic yard, driven by 15 horse-power motors.

Winches : Three electric winches, capable of lifting 1000 lb. at 150ft. per minute, and two steam winches, to lift 3000 lb. at 200ft. per minute.

Locomotives : Two Davenport saddle-tank type locomotives, cylinders 10in. by 14in., with a tractive effort of 6770 lb.

Rolling stock : Twenty 5-ton flat and ten 5-ton hopper wagons and four water trucks.

Ropeway : 1¼ mile long single-rope type, 3in. by 6/7 rope, carrying 5 cwt. net load at 3 miles per hour, capacity 10 tons per hour, driven by 17 horse-power engine.

List of Principal Items of Plant in Operation at the Avon Dam.

Sub-station transformers : Three single-phase transformers of 210 kilovolt-ampères capacity, ratio 33,000/415 volts.

Cableways : Two Lidgerwood cableways of 1200ft. span and 15 tons capacity, maximum traversing speed 750ft. per minute, maximum lifting speed 15 tons at 150ft. per minute and higher speed for lighter loads, fitted with shock-absorbing fall-carriers and dumping gear. Main cable 2¼in. diameter. Driving motor 275 horse-power, also friction winches for traversing the towers. Head tower 50ft. high, tail tower 40ft. high.

Air compressors : Three Ingersoll-Rand 12in. by 12in. compressors, belt driven by 60 horse-power motors, compressing to 95 lb. per square inch.

Locomotive cranes : Three driven by 45 horse-power motors, to lift 15 tons at 20ft. and 7½ tons at 40ft. radius at speeds of 20ft. and 50ft. per minute respectively.

Derrick cranes : Four stiff-leg type, to lift 15 tons at 40ft. radius at a speed of 25ft. per minute. Driven by 30 horse-power motors with a separate 11 horse-power motor for slewing.

Crushers : Two 20in. by 12in. Jacques jaw crushers, driven by 35 horse-power motor. One pulveriser of 7 tons per hour capacity, driven by 30 horse-power motor.

Mixing plant : One canvas belt and bucket elevator of 30 tons per hour capacity. Three "Multimix" batch concrete mixers, 40 cubic feet capacity, driven by 25 horse-power motors.

Transport : Four 4-ton type J. I. Thornycroft petrol-driven motor lorries, one 2½-ton petrol lorry, and one 5-ton steam lorry.

It is interesting to note that the cableways at the Avon Dam, with the exception of the motors and hauling ropes, were designed and constructed in Australia, as also were the electric, locomotive and derrick cranes in operation on both dams.

As previously stated, the catchment area on which these dams are being constructed is in normal times practically uninhabited. A certain proportion of the flow of the Cordeaux and Avon Rivers as at present unregulated, passes into domestic use in the City of Sydney and its suburbs, and the greatest care is, therefore, necessary to preserve these watercourses from pollution. The construction of the dams has necessitated the concentration of a considerable number of men with their families and others engaged in supplying their needs upon the catchment area in the vicinity of the dams, and particular care has been devoted by the engineers responsible for the work to the housing of these people and the sanitation of their surroundings. Village sites have been arranged adjacent to the works. Single storey barracks, in which one small room or compartment is provided for each two men, have been erected for the single men, while allotments of land have been placed at the disposal of the married men, the department affording them assistance to construct temporary houses for themselves and their families. The streets in the villages are metalled and have concrete kerbs and gutters, the whole of the storm and slop water being led through aerating filters and thence treated on sandbeds in an adjoining creek, so that the effluent from the sandbeds must travel a considerable distance before reaching the river itself. All deleterious matter other than the above is removed from the area. Special care is taken with regard to the health of the men and their dependents, a resident medical officer being stationed on the work, while a well-equipped motor ambulance stands always in readiness to convey any case to the nearest hospital, distant in the case of each of the dams some 20 miles from the work. A small weekly charge is made to the employees for the use of the barracks and medical

FIG. 4—CUT-OFF TRENCH IN FOUNDATIONS OF AVON DAM

attention. Shower baths and recreation rooms are provided in connection with the single men's barracks. Public school and recreation halls are also provided.

The construction of the Cordeaux and Avon reservoirs is being carried out by the Public Works Department, N.S.W., without the intervention of a contractor. Mr. E. M. de Burgh, M. Inst. C.E., Chief Engineer of the Water Supply and Sewerage Branch, is the responsible officer for the design and construction, Mr. C. Simons, Wh. Sch., being inspecting engineer. We desire to acknowledge our indebtedness to Mr. de Burgh for the particulars contained in the foregoing, and also for the photographs and drawings with which the article is illustrated.

The Institution of Engineers of Australia.

We have recently received Volume I. of the "Transactions" of the Institution of Engineers of Australia. It brings the history of this Society, which was established in August, 1919, down to the end of the year 1920, and it was published in 1921, so that it has been rather a long time in reaching us. It is, however, none the less welcome for that, for it is an exceedingly interesting publication.

We learn from the "Constitution," a copy of which is given, that the objects for which the Institution was formed were "to promote the science and practice of Engineering, and, generally, to bring about a closer co-operation of Engineers throughout the Commonwealth of Australia, for the acquirement and interchange of professional knowledge, the encouragement of original research, and the advancement of the Engineering Profession." The body consists of Honorary Members, Members, and Associate Members—who are the Corporate Members—and of Juniors, Students, and Associates. All Corporate Members are entitled to vote, but Members and Associate Members only may hold office. Juniors, Students, and Associates possess all the rights and privileges of Corporate Members, except the right to vote or hold office. Members must be at least thirty-three years of age, and Associate Members at least twenty-five years of age. A Candidate for Membership must have been engaged in some section of engineering for at least twelve years, during which period he must have "occupied a responsible position in the design, construction, management or operation of important work or plant for at least five years, and shall have acquired some degree of eminence in his profession." The period of twelve years may, at the discretion of the Council, be reduced to ten years in the case of a candidate who is an Associate Member or one who has graduated in a School of Engineering recognised by the Council, or who has passed such other examination as, in the opinion of the Council, is considered sufficient. Every Candidate for Associate Membership has to pass an examination before a Board of Examiners appointed by the Council, but he may be exempted from examination if :—

"(*a*) He has already passed an examination which, in the opinion of the Council, is equivalent to the Associate Membership Examination ; or

"(*b*) Having attained the age of thirty years, he can produce evidence that he has had, excluding apprenticeship, pupilage, or training, at least eight years' experience, partly in the office and partly in or upon engineering plant or work, provided that such experience shall be deemed satisfactory by the Council."

The Council of the Institution consists of a President, two Vice-Presidents, two Past-Presidents and not more than thirty Councillors. The tenure of office is : for the President, one year ; for the Vice-Presidents, two years ; for the Past-Presidents, two years ; and for the Councillors, one year. Full Members pay an entrance fee of five guineas and an annual subscription of four guineas. Associate Members pay an entrance fee of three guineas and an annual subscription of two guineas ; Juniors an entrance fee of a guinea and an annual subscription of a like amount, while Students pay an annual subscription of half a guinea, but no entrance fee ; and Associates an entrance fee of three guineas and an annual subscription of two guineas.

The Institution is an amalgamation of the majority of pre-existing Engineering Societies in the Commonwealth. Its possible formation had been under discussion in various quarters for a number of years, but nothing tangible was effected, until in November, 1917, the South Australian Institute of Engineers sent a letter to all other interested societies in the Commonwealth, definitely suggesting a general affiliation of Engineering Associations and suggesting an inter-state conference. As a result a meeting of delegates from a total of fourteen Institutions in various States met in Melbourne on February 12th, 1918. The only two societies not represented at the conference were the Western Australian Institution of Engineers and the Melbourne University Engineering Society, so that the gathering was very nearly representative of every engineering body in the Commonwealth. The outcome of its deliberations was that several resolutions were passed, two of which were as follows :—

"That this meeting of delegates recommends that the various engineering bodies of the Commonwealth of Australia shall combine and form an institution to conserve the interests of the engineering profession therein ;" and "That in the opinion of this conference it is desirable that the Constitution shall provide for the merging of the whole of the present societies into a single institution of which the present societies will become sections, and it is the intention of the conference that existing societies should, as far as possible, preserve their present individual entity, and that Federal control should be generally restricted to Federal matters."

A Provisional Council consisting of two members from each purely State Society and three from each Federal body was elected, its first duty being to draft a Constitution and to submit it to the associating societies for consideration. It was charged to meet not later than May 15th, 1918. It actually met on May 15th and 16th of that year, when every Engineering Institution in the Commonwealth was represented. The draft Constitution, after revision, was, on March 13th, 1919, sent to each society, and it was accepted by the following bodies, which agreed to join the new Association :—

The Queensland Institute of Engineers.
The Northern Engineering Institute of N.S.W.
The Institute of Local Government Engineers of Australasia, N.S.W. Branch.
The Institute of Local Government Engineers of Australasia, Queensland Branch.
The Electrical Association of Australia, N.S.W. Section.
The Electrical Association of Australia, Victorian Section.
The Engineering Association of N.S.W.
The South Australian Institute of Engineers.
The Western Australian Institution of Engineers.
The Tasmanian Institution of Engineers.
The Sydney University Engineering Society.
The Melbourne University Engineering Society.

Only three of the pre-existing societies in Australia decided against joining. They were :—The Australasian Institute of Mining and Metallurgy ; the Victorian Institute of Engineers ; and the Victorian Branch of the Institute of Local Government Engineers of Australasia. The first Council of the new Institution met at the Royal Society's House in Sydney on October 20th and 21st, 1919. Professor W. H. Warren, M. Inst. C.E., was elected first President ; Messrs. W. J. Newbiggin, of the Melbourne Division, and F. W. Lawson, of the Perth Division, being elected Vice-Presidents ; with Mr. D. F. J. Harricks as Hon. Secretary and Mr. J. P. Tivey as Hon. Treasurer.

The first annual general meeting of the Institution was held at the Royal Society's House, Sydney, on December 10th, 1920. Professor W. H. Warren delivered his Presidential Address, choosing for his subject the circumstances which had led up to the formation of the Institution. At the meeting it was announced that the President for the year 1921 was Mr. W. J. Newbiggin, of Melbourne, and that Mr. E. S. Maclean had been appointed Secretary to the Institution.

At the end of December, 1920, the membership roll was as follows :—

Members	124
Associate Members	1352
Associates	12
Juniors	182
Students	188
Total	1858

Reprints of selections of papers read before different

Divisions of the Institution are, with their illustrations, given at the end of the volume. Short abstracts of other papers are also provided. Altogether some thirty-nine papers and addresses were, apparently, read before the various Divisions, the subjects varying as widely as from "Harbour Improvements at Port Kembla" to "A Method of Taking a Sulphur Print;" and from "Modern Lathes" to "The River Murray Works." Many of them are of considerable value, and, on the whole, the first volume of he Transactions of the Institution—which, by the way, talso includes a list of members—is a most creditable production.

South-East Lancashire Electricity Board.

THE South-East Lancashire Electricity Advisory Board, which has been in process of formation for two years, has now become a statutory authority, Parliament having, on Monday last, confirmed the Order constituting the Board made by the Minister of Transport upon the recommendation of the Electricity Commission. The initial step which gave rise to the formation of the Board was taken by the Electricity Commissioners in June of 1920, when, in accordance with the powers vested in them by Sec. 5 of the Electricity Supply Act, 1919, they provisionally determined the South-East Lancashire area as a separate electricity district, and gave notice that it appeared to them that the organisation for the supply of electricity in the district should be improved. Thereupon, a conference of all authorities in the area formulated a scheme, which was unanimously agreed to be the best possible engineering development of the area. The conference also designed the constitution and powers of an advisory board, which they were willing to set up to supervise future electrical development and to secure that such development should be on the lines laid down in the technical scheme. The Commissioners held an inquiry into this scheme in January, 1922. The Conference experienced much criticism for the reason that it had not indicated its willingness to participate in the formation of a joint electricity authority which should own and operate all stations and main transmission lines in the area. In spite of these criticisms, the South-East Lancashire authorities remained unanimous in their preference for the establishment of an advisory board. The Electricity Commissioners thereupon, after a three-days' inquiry, indicated their willingness to make an Order formally constituting an advisory board on the lines suggested. Since the date of this inquiry, the Commissioners have published the Order constituting the Board and held a second inquiry thereon to consider drafting amendments, and, ultimately, all such matters having been disposed of, the Commissioners formally made the Order, and the Minister of Transport has now secured the approval of both Houses of Parliament thereto. The Board thus becomes a real and important body, which will play a very vital part in all future electrical development. It will not be possible in the future for any local authority or company in the area to construct new generating stations or main transmission lines, or to enter into contracts in relation to bulk supplies, without first submitting the details thereof to the Board. The Board will thereupon examine the proposals and ascertain if they are in accordance with the agreed technical scheme, and if they are in the interests of the district as a whole. Subject to appeal to the Commissioners, the authorities are under obligation to act upon the advice of the Board.

It is obligatory upon the Board to appoint an Engineering Advisory Committee to guide them in their deliberations, which Committee will obviously be one of great importance, carrying heavy responsibilities.

As our readers are already aware, the area of the Board's jurisdiction extends approximately from Wigan on the west to Glossop on the east, and from Ramsbottom–Whitworth–Littleborough on the north to Knutsford–Macclesfield–Buxton on the south. This area is by far the most important electrical area outside London, as will be realised when it is pointed out that one-tenth of the whole electrical output of the United Kingdom is generated therein.

It is significant of the important lead given by South-East Lancashire, that since the principle of an owning and operating authority was abandoned in favour of an Advisory Board, several other important areas have followed suit; moreover, although the preliminary notice by the Commissioners was issued in South-East Lancashire many months later than in certain other areas, the South-East Lancashire Electricity Advisory Board is the first authority of any kind to be set up as a result of the recent legislation for reorganising the electricity supply industry.

An Interim Board has been operating since October 17th last in all respects as though Parliament had approved the Order, and has taken offices in Manchester.

Alderman W. T. Dagnall, the chairman of the Manchester Corporation Electricity Committee, was appointed chairman of the Interim Board, which consists of some fifty representatives of all authorised undertakers and other local authorities and railway companies in the area.

The Engineering Advisory Committee of the Interim Board consists of the following gentlemen:—Mr. S. L. Pearce, Manchester; Mr. C. D. Taite, Lancashire Electric Power Company; Mr. W. J. H. Wood, Bolton; Mr. S. J. Watson, Salford; Mr. F. L. Ogden, Oldham; Mr. R. Lomax, Stockport; Mr. R. Owen, Wigan; Mr. G. H Fawcus, Altrincham Electric Supply Company; Mr. H. C. Busbridge, Swinton and Pendlebury.

The Stalybridge, &c., Joint Board has the right to send its engineer to any meeting of the Engineering Advisory Committee at which matters are to be considered affecting the area of the Stalybridge Board or areas contiguous thereto, and the Engineers' Committee is entitled to co-opt the engineers of the railway companies. Mr. S. L. Pearce, C.B.E., M.Sc., the chief engineer and manager of the Manchester Corporation electricity department, was appointed, and has acted as chairman of the Engineering Advisory Committee of the Interim Board. All appointments of chairman, committees, &c., will, of course, require to be formally made by the statutory Board at its first meeting, which must take place within six weeks from the date of the confirmation of the Order.

Mr. A. H. Banks, late chief assistant to the Town Clerk of Manchester, was appointed clerk to the Interim Board, on the understanding that he would be the clerk to the statutory Board. At the request of the Interim Board, Sir John Snell, the chairman of the Electricity Commission, has indicated his willingness to preside at the first statutory meeting of the Board.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

OIL ENGINE NOMENCLATURE.

SIR,—I have read with great interest the notice you published in THE ENGINEER, February 23rd, 1923, under the above title, being extracts from a paper read by Mr. John L. Chaloner before the Institution of Automobile Engineers on February 15th, 1923.

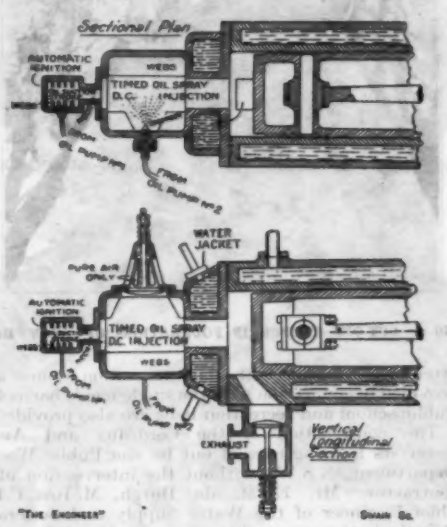
Now, it is established that all automatic ignition heavy oil engines work according to one or the other of my Akroyd automatic ignition heavy oil engine cycles of 1890, or a combination of them—see the accompanying sketch.

Reference to the above combination of Akroyd vaporisers was made in my letter published in THE ENGINEER on November 4th, 1921.

"The Akroyd" is the original fundamental principle on which all heavy oil engines work; also it is the original combination principle. For all-round purposes it is possible to classify all heavy oil engines on a compression pressure basis. Class No. 1 medium compression Akroyd hot bulb (automatic ignition), Class No. 2 high compression Akroyd cold bulb (automatic ignition). These terms express the original and the true historic evolution of the modern heavy oil engine. The Hornsby, the Petter automatic ignition heavy oil engines are examples of Class 1 engine, whilst the Ruston, the Crossley, Vickers automatic ignition heavy oil engines are examples of Class 2 engine.

If manufacturers of the oil engines in question would get together and determine the limit compression pressure for practical working for the Class 1 engine, then the Class 2 engine provides for all other compression pressures. Also it would be advisable that each manufacturer should describe and illustrate the special patented device used to "spray" or "atomise" the liquid fuel for combustion.

Mr. Chaloner, in his paper above referred to, states that the



Akroyd cycle, the "Hornsby-Akroyd," is a low compression oil engine, and that engine cycle is obscure. Such a statement is wrong and misleading. The patent specification No. 15,994, October 8th, 1890, provides that the oil may be injected on the compression stroke—see page 1, lines 46, 47, 48:—"The engine shown in the drawing is designed to have the liquid hydrocarbon injected into the explosion chamber and formed into 'spray' *before* impinging upon the heated walls of the said chamber, &c. &c." Page 2, lines 1, 2, 3:—"The injection may be so timed as to occur at the beginning or any portion of the suction stroke or during the *compression stroke*."

May I ask the favour that further comment on my early Akroyd automatic ignition heavy oil engine cycles may refer to my work as a whole. As described in the specifications and drawings of Patents No. 7146, May 8th, 1890; No. 15,994, October 8th, 1890; Akroyd water or fuel-oil cooled vaporiser, No. 3909, February 20th, 1892.

Those were the basic principles I laid down thirty years ago to produce eventually an efficient and reliable oil engine. Akroyd engines built according to the above-mentioned patents were sold and in daily use before Dr. Diesel took out his *first* patent for oil engines in Great Britain.

In order to prove the above statement that the modern automatic ignition heavy oil engines are a natural evolution of my Akroyd engines of 1890, I am prepared to build an Akroyd automatic ignition heavy oil engine according to the specifications and drawings of Patents No. 7146, May 8th, 1890; No. 15,994, October 8th, 1890; and Akroyd water or fuel oil cooled vaporiser Patent No. 3909, February 20th, 1892. Such an Akroyd engine to work on a compression pressure starting from 45 lb. per square inch (hot bulb, Class 1), rising in stages up to 400 lb. per square inch (cold bulb, Class 2), as set out in the paper read by Mr. Livens before the members and Council of the Institution of Mechanical Engineers at Lincoln, July, 1920:

That Akroyd oil engine to use oil as fuel from the start, specific gravity .854, "Russolene" or "Scotch shale oil," similar to that used in the Akroyd automatic ignition oil engine which Professor Robinson tested for me at Bletchley Ironworks, Bletchley, Bucks, February, 1891, the density of the oil to be increased as compression pressure is increased and the cooled surface of the combustion chamber extended until the high compression pressure stage of 400 lb. per square inch is reached, when the surface of the combustion chamber will have been entirely cooled (Class 2 cold bulb engine).

Apropos to the dual or compound Akroyd vaporisers, "two oil injection method," it may interest your readers to know that in 1905 Messrs. Crossley Brothers, of Manchester, altered one of their Crossley oil engines, 20 brake horse-power, to work according to my "two oil injection method," Patent No. 28,045, December 21st, 1904.

Mr. W. Le P. Webb, Messrs. Crossley Brothers' oil engine expert, tested that 20 brake horse-power engine, and his report on it was very satisfactory; in fact, I submitted it for perusal to the members of the Oil Engine Nomenclature Committee during their term of office at the Institution of Mechanical Engineers, London.

HERBERT AKROYD STUART.

Claremont, April 20th.

DESIGN FOR AN EXPRESS LOCOMOTIVE.

SIR,—Mr. Poultney's suggested design for a 4–4–2 three-cylinder express locomotive is, on the whole, excellent. As Mr. Poultney says, "Everyone has his own ideal of what a locomotive should be," and I differ from him on two points:—(1) Close observation of the working of heavy express trains has satisfied me that six coupled wheels are necessary if time is to be kept under all weather conditions. (2) I consider three separate sets of Stephenson valve gear unnecessarily complicated and expensive. Instead, I would have two sets only of Walschaerts gear for actuating the outside valves, and couple the inside valve spindle to these by the simple system of conjugated levers, as used by Mr. H. N. Gresley in his famous three-cylinder engines on the London and North-Eastern Railway. In other words, Mr. Gresley's 4–6–2 engine is my ideal for an all-round economical locomotive for working heavy express trains.

In proportion to its power, this engine has fewer working parts than any other type at present running in this country, and is therefore less likely to get out of order. Having only a single-throw crank axle, there is plenty of room for large bearings, both for the inside connecting-rod "big end" and the axle, ensuring a long life.

The four-cylinder engine suggested by Messrs. Brewer in your issue of May 11th, in which the adjacent inside and outside cylinders have their crank centres arranged at an angle of 135 deg. to each other, is a most interesting design. My only objection to it is that four separate sets of valve gearing would be necessary.

Locomotive economy is a very elusive thing. Compound enthusiasts often look only at the coal bill, as though that were the only thing to be considered. My objection to compounding, so far as British locomotives are concerned, is that it is almost impossible to arrange to have the low-pressure cylinders sufficiently large in diameter for successful compound working.

Low-pressure cylinders 25½in. diameter have been suggested by your correspondents, but these could not be placed outside the frames of an English locomotive, and, if located inside, the framing would have to be cut away to accommodate them; or, as an alternative, the cylinders would have to be stepped, one in front of the other, as was done some years ago in the 4–6–4 four-cylinder compounds on the Northern Railway of France. This is, to say the least, a clumsy arrangement. For a given power, four-cylinder compound engines cost more to build than three-cylinder simple engines, for they require a double-throw crank axle, and, to work successfully, four sets of valve gearing. Their oil consumption would also be greater.

No, Sir, for all-round economy Mr. Gresley's type of 4–6–2 three-cylinder engine will take a lot of beating.

Birmingham, May 28th. CHAS. W. DAUNCEY.

MOTOR LIFEBOAT AT CROMER.—The new motor lifeboat for Cromer, which has been built by the Royal National Lifeboat Institution, has just been completed and has now reached her station. She is a boat of the Norfolk and Suffolk type, 46ft. 6in. by 12ft. 9in., and is fitted with one of the Institution's new six-cylinder engines, developing 90 horse-power. She is the second boat to be fitted with this new engine, which was described in THE ENGINEER of December 22nd, 1922, and is the largest and most powerful lifeboat at present on the coast, although still larger boats are under construction. The Cromer boat is named the H. F. Bailey, having been built out of a legacy of £10,000 which the Institution received from the late Mr. H. F. Bailey, of Brockenhurst, Hants. There are now forty motor lifeboats in the Institution's fleet of 235 boats, and a number more should be completed and sent to stations before the end of the year.

THE OIL CONFERENCE.—The following is a list of the papers to be read at the Oil Conference, to be held at the sixth International Mining Exhibition, 4th to the 8th inst.:—Monday, June 4th: "The Riddle of the Carpathians" (opening address), by E. H. Cunningham Craig; "Oil Deposits and the Tectonics of Vertical Pressure," by Dr. Maxmilian Kraus; and "Note on the Genesis of Hydrocarbons and their Localisation in Certain Zones of the Earth's Crust," by R. d'Andrimont. Tuesday, June 5th: "Oilfield Waste," by A. Beeby Thompson, M.I. Mech. E. Thursday, June 7th: "The Mode of Appearance of the Petroleum Deposits in the Carpathian Region, with General Consideration on the Genesis of the Petroleum and the Source of the Actual Deposits," by J. Voitesti, Professor Cluj University; and "An Economic Study of Petroleum Mining by Underground Drainage," by Major J. A. Lautier. Friday, June 8th: "The Standardisation Movement in America and its Relation to and Application Towards the Elimination of Waste in the Petroleum Industry," by C. A. Young and S. D. Tuthill; and "The Caribbean Oil Region," by George Howell.

COVENTRY LIBRARIES.—The Committee of the City of Coventry Public Libraries reports that 184 volumes and no fewer than 5990 pamphlets were added to the Commercial and Technical Library during the past twelve months. The information file, consisting of clippings from newspapers and periodicals (particularly technical journals), "separates" from "Transactions" and "Proceedings" of institutions, and pamphlets, now contains approximately 6500 items. The file is found to be particularly valuable when answering technical inquiries, as it contains, in strictly classified order, all the important articles clipped from the latest periodical literature. These items are arranged in the same classified order as the books on the shelves, and its value has been proved over and over again. Whilst the file includes every subject of importance, particular attention is paid to the industries of the city—automobile engineering, machine tool engineering, chemical and metallurgical engineering—and a separate file of 2250 pamphlets and articles relating to the locality is preserved in the Coventry and Warwickshire collection on the first floor of the library. During the year a trade catalogue section has been established. Applications have been made to representative firms covering all phases of industry for copies of their catalogues, which are filed on the Coventry Extension of the Dewey Decimal Classification, which is in use throughout all departments of the libraries.

A Seven-Day Journal.

Helium.

A SMALL pamphlet, entitled "Helium Gas and its Uses," written by Professor J. C. McLennan, of Toronto University, has just been issued by the British Science Guild, with the object, apparently, of urging the view that the development work done during the war in connection with the production of this gas should be continued by the joint efforts of the British and Canadian Governments. The principal source of helium is natural gas, occurring in the Western States of America, especially Texas, which contains from one to two per cent. of the element. In France some springs are known which contain five per cent. of the gas. The natural gases of Ontario and Alberta yield about one-third per cent. of helium, while the supply found at Heathfield, Sussex, shows about one-fifth, and the King Spring at Bath about one-sixth per cent. At the present moment, according to Professor McLennan, the United States are producing thirty to forty thousand cubic feet of helium per day. It is being compressed and stored for use in airships, &c., and its export is prohibited. At Calgary, it is stated, the plant erected and operated for a time during the war is now idle, although it is capable of producing helium of a high degree of purity at a cost of less than fivepence a cubic foot. The principal use suggested for the gas is as a substitute for hydrogen in airships. It is also of use in connection with the attainment of very low temperatures and for filling thermionic valves and incandescent filament lamps. While it would be unwise to prophesy that a plentiful supply of helium would not greatly affect the outlook for the airship, it seems evident that much more development work must be faced before the possibility of so using the gas on a commercial scale can be seriously contemplated, for at fivepence per cubic foot the charge required for quite a moderate size of airship would cost from twenty-five to thirty thousand pounds.

Encouraging Aeronautics.

THE fact that on re-appointment as Secretary for Air in Mr. Baldwin's Government Sir Samuel Hoare has been given a seat in the Cabinet is regarded in aeronautical circles as a very encouraging sign that the new Government means to devote increased attention to aerial matters. Sir Samuel, it is agreed on all hands, has acquitted himself so far most satisfactorily in his dealings with military and civil aviation and the aeronautical industry, and his retention of his former post is regarded with as much satisfaction as his promotion to Cabinet rank. The industry has also received encouragement this week by the Air Ministry's announcement that until further notice it is prepared to purchase each year for a sum not exceeding £3000 the winning machine, minus the engine, in the Aerial Derby and the Schneider Cup races. These races, the first of which is to be held at Hendon on August 6th and the second at Cowes on September 27th and 28th, are international in character; but the Ministry's offer extends only to machines which are of British design, construction and ownership, and, moreover, is restricted to types which have not previously won the races. The Ministry considers the production of machines capable of winning these races as representing a definite advance in design and proposes to conduct official military experiments on the machines after it has purchased them.

Chester Munitions Store.

SEVEN years ago the erection and equipment of the Ministry of Munition's explosives store and refinery plant at Chester cost the country round about half a million sterling. The establishment has now been sold to the Anglo-Scottish Finance Corporation for the sum of £30,000, the cost, it is said, originally involved in building the brick wall surrounding the factory. The establishment is situated on the river Dee and can be reached by steamers of 2000 tons capacity. Its sidings are connected both to the London, Midland and Scottish and the London and North-Eastern railway systems, and the freehold site extends to thirty acres. It is stated that the works will be used by the Corporation for the production of petrol and benzene from raw gas and other oils in accordance with a new process developed by Dr. Hermann Wolf, the chief chemist of the Baden Aniline Company.

The Railway Shopmen's Ballot.

THE result of the joint ballot taken by the Federation of Engineering and Shipbuilding Trades, the National Union of Foundry Workers, and the Workers' Union among the craftsmen employed in the railway shops was officially announced on Monday to show a majority of two-thirds against the acceptance of the railway companies' proposals for the reduction of wages. The terms proposed were a reduction of 2s. a week in May, of 1s. in June, and of a further unspecified amount to be determined before the end of the year. The negotiations in the matter have been very prolonged and had for their object, on the companies' side, the reduction of the shopmen's wages to the level of those paid for similar services by outside engineering firms. It has been suggested that, following the result of the ballot, the companies would have no alternative but to post notices against the shopmen; but according to one of their officials the situation, though delicate, does not give cause to believe that a lock-out will take place or that the difficulty which has arisen will be overcome otherwise than in a common-sense manner. It may be recalled that should a strike or lock-out occur among the shopmen the unions to which the general body of railwaymen belong have promised to lend them their active support.

The Prince of Wales in Sheffield.

AMONG the engagements fulfilled by the Prince of Wales during his visit to Yorkshire this week was an inspection of the East Hecla Works of Hadfields Limited, in the course of which he started up the firm's new 28in. electrically driven rolling mill, which we illustrated and described in our issue of August 11th last year. This mill is capable of rolling down at one heat 15in. square ingots 5ft. long to 2¼in. square billets, and is designed for a normal output of about 1500 tons per week. It has been completed for some time past, but because of the present unfortunate condition of the iron and steel trades there has so far been no opportunity of using it industrially. Another event in the history of Hadfields was the opening last Saturday of the firm's sports ground. This ground extends in area to about fourteen acres and is situated at a distance of about fifteen minutes' walk from the East Hecla Works. It comprises facilities for cricket, football, hockey, bowling, tennis, and running. That such amenities are appreciated by those for whom they are provided is shown by the fact that the Hadfield Sports Club already numbers about twelve hundred members.

Recent Clyde Orders.

A SHORT time ago it was announced that Andrew Weir and Co., of London and Glasgow, had placed an order with Harland and Wolff's Govan shipyard for three 380ft. single-screw motor vessels. We now learn that a further order from the same owners has been received for three twin-screw motor ships of 420ft. length. These orders, together with six oil-carrying barges which are to be built at Govan for the West African Coast service of the Elder-Dempster Company, Limited, will mean a spell of continued work for the Govan shipyard. All the propelling machinery for the six ships, together with that for the motor ship which is to be built at Meadowside for the Nippon Yusen Kaisha, of Tokio, will be constructed at Harland and Wolff's Diesel Engine Works at Glasgow. The single-screw ships will be equipped, we understand, with the long-stroke type of engine, which was described in our issue of April 27th, while standard twin-screw Diesel machinery will be fitted in the larger ships.

The Boilermakers' Dispute.

SIGNS are not wanting that the dispute between the Boilermakers' Union and the Shipbuilding Employers' Federation is reaching its concluding stages. The men at some of the centres, notably at Barrow and on the Tyne, are expressing restiveness against the attitude adopted by their leaders and are asking permission to hold conferences of branch representatives to discuss the situation. Possibly because of these indications that the members were becoming dissatisfied, the Union leaders towards the end of last week approached the Employers' Federation with a view to arranging a meeting for the discussion of the dispute. The Federation of Engineering and Shipbuilding Trades having informed the employers that, following the expulsion of the boilermakers from its ranks, it could no longer act on their behalf, the Employers' Federation decided to agree to the proposed meeting. The conference began in London on Wednesday.

The Engineering Joint Council.

PARTICULARS are now available of the constitution and by-laws of the Engineering Joint Council founded last year by the Civil, Mechanical, and Electrical Engineers, and the Naval Architects. The Council is to consider matters referred to it by the Council of any one of the constituent Institutions. It is to act in an advisory capacity without executive powers and is not to initiate proposals affecting the Institutions. It is to consist in the first instance of eight members, two appointed by each of the founder Institutions. The chairman is to be elected annually and is to be chosen from the several Institutions in rotation. The secretary of the Institution represented by the chairman for the year is to be the secretary of the Council. Provision is made for the admission of other institutions or societies to representation on the Joint Council. Such other bodies are to be classified in two groups. In the first are bodies to be known as constituent institutions, which represent important branches of engineering and which have adopted examinations or equivalent qualifications for admission to their corporate membership. Such institutions would have one representative on the Joint Council, who would be entitled to vote. In the second group are bodies to be known as affiliated institutions, whose interests are already represented on the Council by reason of a large proportion of their members also belonging to the founder or constituent institutions and whose membership is not necessarily confined to engineers. These affiliated bodies would have the right to refer questions to the Joint Council and to be represented at the meeting of the Council at which such questions were under consideration, but their representatives would not be given a right to vote.

Liner Speed in the Solent.

WE understand that complaints have been brought to the notice of the Mercantile Marine Department of the Board of Trade by the Lords Commissioners of the Admiralty regarding the excessive speed of liners in the Solent. The matter was considered at the monthly meeting of the Southampton Harbour Board on Friday last, when the Works and Harbour Committee reported on a letter received from the Mercantile Marine Department. It was stated that the Admiralty suggested that a parliamentary Bill should be introduced to limit any vessel navigated in the Solent to a speed not exceeding 15 knots through the water, or 10 knots when the vessel was at a distance of less than half a mile from the shore. The Committee resolved to recommend the Harbour Board to protest against the fixing of a defined speed, its view being that vessels should be navigated at such moderate speed as would not cause loss or injury to life or property in the waters or on the shores of the Solent.

A Year's Patents.

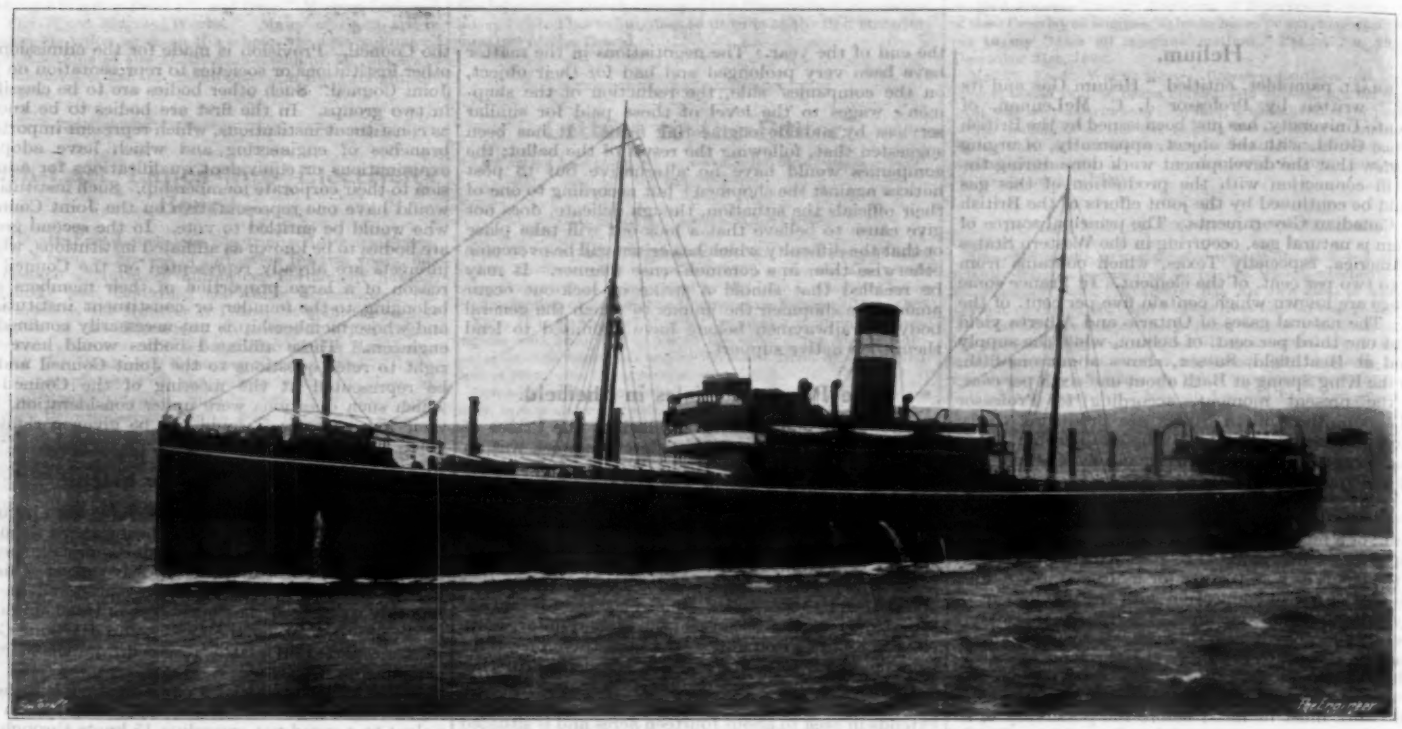
THE report of the Comptroller-General of Patents, Designs and Trade Marks for the year 1922, issued on Tuesday, shows a surplus of receipts over expenditure of £74,074. The total receipts amounted to £493,133, towards which patents fees contributed £413,378, trade marks fees £46,045, and designs fees £10,373. Although the receipts from patents fees showed a decrease of some £32,000 as compared with those of 1921, the total number of patent applications, 35,494, was 362 greater and the number of complete specifications filed, 19,060, was only 99 less than in 1921. Sixty years ago, as our own files show, the question of the disposition of the surplus realised by the Patent Office was a subject of hot debate. It was contended by the Inventors' Institute that it was neither politic nor right to subject inventors to more expenditure than was strictly necessary to meet the official expense necessary to secure to them the protection sought. It was further urged that the surplus of £270,000 accumulated in the nine years 1852 to 1861 should be expended on some public purpose in connection with the encouragement of inventors and the progress of practical science, and not be paid into the Government taxation account. To-day the surplus earned still goes to the Treasury.

Sixty Years Ago.

IN a note in our issue of May 29th, 1863, particulars were given of the efforts then being made to devise some satisfactory method of protecting the bottoms of iron ships from corrosion. It was held by many in those days that the best method of securing protection was to apply red lead to the scraped and bare plates; but in our note it was pointed out that such a procedure was contrary to chemical and scientific opinion. The view was urged that a ship's bottom coated with red lead sweated when in salt water, the pigment blistering and depositing metallic lead on the iron. Each blister became a miniature galvanic battery and corrosion inevitably followed. The Admiralty, it was recorded, had been conducting experiments for a long time at Portsmouth and had developed a method of electro-coating iron with zinc in a very superior manner. A still more promising method of French origin was, at the date, about to be experimented with. It consisted apparently of some method of electro-deposition of copper on the iron. A paragraph on the Mail Steam-packet Service recorded that the British Government was then subsidising 130 channel and ocean mail steamers. The mail steam-packet service had been in existence twenty years, and during that period about thirty vessels had been wrecked, involving the loss of more than 2000 lives and £3,000,000 worth of property. Almost all the vessels were lost in fogs or in darkness through steaming on to keep time with the mails.

THE MOTOR CARGO SHIP DALGOMA

ALEXANDER STEPHEN AND SON, LIMITED, LINTHOUSE, GLASGOW, BUILDERS AND ENGINEERS



The Motor Cargo Ship Dalgoma.

THE motor cargo ship Dalgoma, which recently completed successful trials on the Clyde, is the latest vessel to be added to the fleet of the British India Steam Navigation Company, Limited. Her general appearance will be seen from the illustration above,

FIG. 1—BROWN-BOVERI TURBO-BLOWER

which was taken during a speed trial on the measured mile at Skelmorlie, on the 17th inst., when a speed of 13 knots was attained. On Wednesday of last week further demonstration trials were made, when we were accorded an opportunity of inspecting the ship and her machinery installation. The Dalgoma has the following principal dimensions: Length between perpendiculars, 430ft.; breadth, 54ft. 6in.; and moulded depth, 32ft. 4in.; with a gross tonnage of 6000 tons and an approximate dead-weight capacity of 8300 tons.

Twin-screw Stephen-Sulzer two-stroke Diesel engines are installed, which give the vessel a sea speed under service conditions of about 12 knots. The arrangement of cargo holds is generally similar to that of the sister motor ships of the same company, there being five holds, each served by four 3-ton electric winches, supplied by the Sunderland Forge and Engineering Company, Limited. These winches are of the worm-driven type with contactor controls, and are amply rated, each winch being capable of dealing with a load of 7 tons. The ship is remarkable for the excellence of the cabin accommodation which is provided for the officers and crew. The adoption of two-stroke machinery has made possible a much smaller engine-room casing than that usual for four-cycle machinery, and this has given extra cabin space, which has been well utilised. Indeed, the degree of comfort in arrangement and furnishings and the general finish of the ship is quite comparable with that usual for passenger vessels.

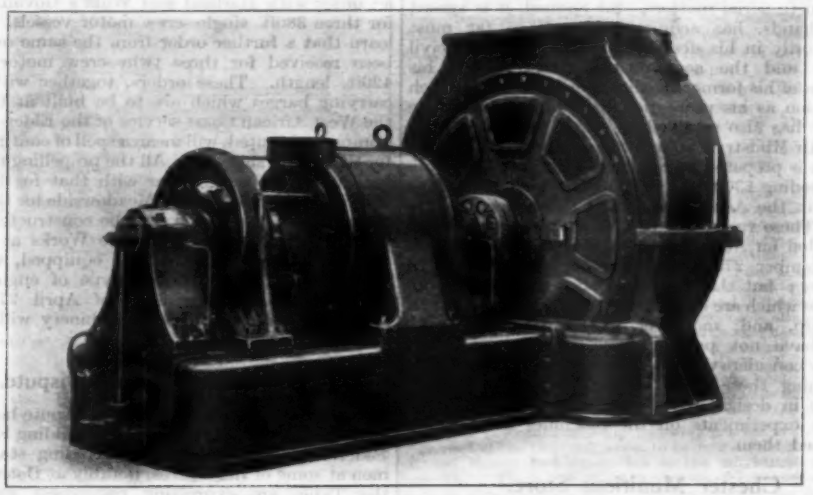


FIG. 2—REAVELL TURBO-BLOWER WITH OERLIKON MOTOR

MAIN AND AUXILIARY ENGINES.

The machinery installation of the Dalgoma marks a further step in advance in British marine Diesel engine practice, for the main engines have the largest cylinder capacity of any Sulzer type engine built in this country, and the installation is the first one in which turbo-blower scavenging has been adopted. In general the main engines are similar in design to those of the Conde-de-Churrucha, which were described in detail in THE ENGINEER of September 16th, 1921. There are, however, certain departures from the earlier design, which we shall refer to later. Each engine has four cylinders, having a diameter of 680 mm. ($26^{12}/_{16}$in.) and a stroke of 1100 mm. (43$\frac{1}{3}$in.) capable of developing 1600 brake horse-power at a normal speed of 85 revolutions per minute. Refer-

TABLE I.—*Readings of Pressures and Temperatures.*

Time.	Port or starboard.	Pressures in pounds per square inch. Air compressor. L.P.	I.P.	H.P.	Injector air.	Scavenging air.	Forced lubrication. Bearings.	Crosshead pins.	Cooling water. Jackets.	Pistons.	Sea water.	Temperatures in deg. Fah. Jackets. Inlet.	Outlet from cyl. covers.	Piston cooling. Inlet.	Cylinders. 1	2	3	4	Fuel valve casing outlet.
1.50 p.m.	P.	12	95	775	772	1.5	8.5	250	10	25	47	47	83	47	118	117	116	121	95
,,	S.	17	115	790	790	1.5	9	250	12	30	47	47	75	47	100	110	98	92	80
3 p.m.	P.	17.5	120	850	850	1.5	9	270	10	28	47	47	90	47	119	116	118	122	100
,,	S.	18.5	122	850	850	1.3	9.5	272	12	31	47	47	82	47	102	112	100	98	90

ring to Fig. 5, it will be noted that the usual piston type of scavenging pump is done away with, and an air compressor only is mounted at the forward end of the engine and driven directly from the extended crank shaft. At this end of the bed-plate there is

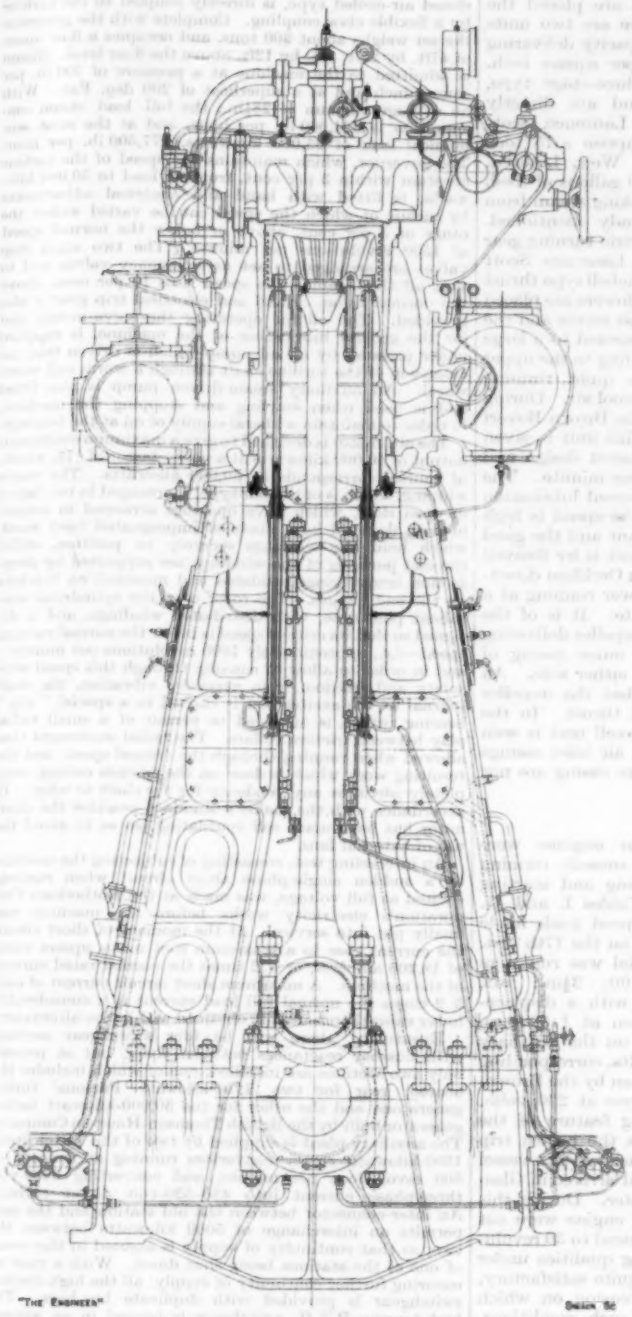


FIG. 3—SECTION THROUGH ENGINE

also a group of three reciprocating pumps, two of which are horizontal and serve as bilge and lubricating oil pumps, whilst the centre one, which is vertical, supplies lubricating oil to the main engine cross-heads at a pressure of 250 lb. per square inch. A vertical section of the engine is shown in Fig. 3. In this case there are two inlets and two outlets for the piston cooling water. This is a modification of the usual design, and has been made to meet the special conditions under which the ship will operate. In the Indian coast service the amount of sediment which is present in river and esturine waters makes it preferable to use fresh water for piston cooling. The cooling water is supplied by centrifugal type pumps which work in connection with a system of overhead cooling tanks, so that they operate under a small head of water. A further interesting feature is the method by which the piston-rod is attached to the main piston head. Large diameter steel bolts of extra length, obtained by steel distance pieces, are used, the additional length giving a more flexible connection than would be obtained by short bolts. Brief reference may be made to the two Diesel engine-driven auxiliary generators, which are also of the Stephen-Sulzer two-cycle type. They are both four cylinder units developing 400 brake horse-power coupled direct to 260-kilowatt 220-volt direct-current generators running at 200 revolutions per minute, and supplied by Laurence Scott. Each engine has its own scavenging pump and air compressor, along with the necessary water-cooling pumps, these being driven directly from the main crank shaft.

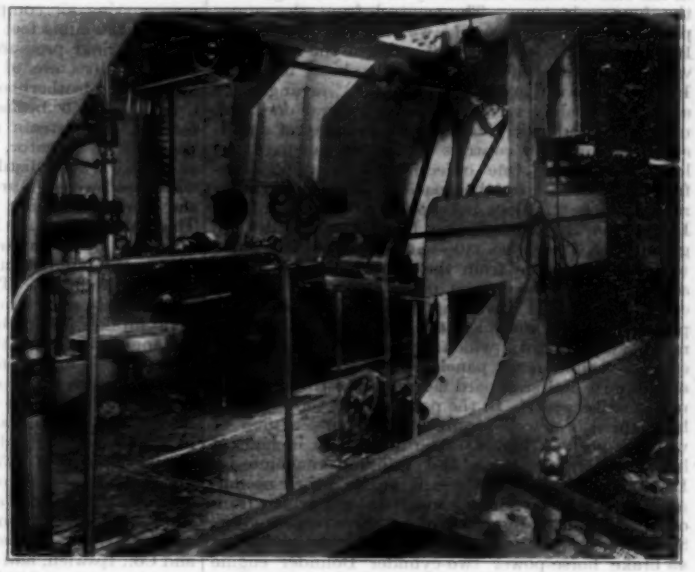


FIG. 4—WORKSHOP AT TOP PLATFORM LEVEL

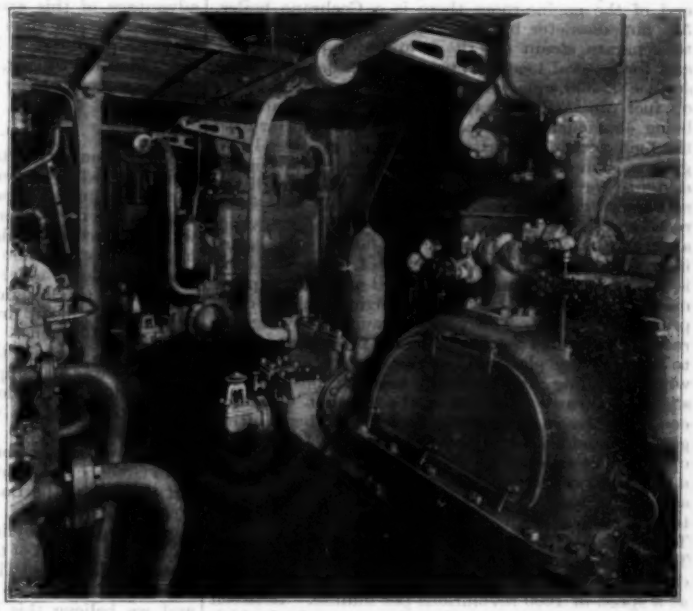


FIG. 5—PUMPS AT END OF MAIN ENGINES

We may now describe the general arrangement of

TABLE II.—*T.S.M.V. Dalgoma : Speed Trials on Measured Mile, Skelmorlie, May 17th, 1923.*

Time.	Mile	Port or starboard.	Engine r.p.m. by counter.	Time for mile	Speed of ship, knots.	Mean speed.	M.E.P., lb. per square inch. Cylinder. 1	2	3	4	I.H.P. Cylinder. 1	2	3	4	Total I.H.P.	Total collective I.H.P.	Total equivalent steam I.H.P.
12.20 p.m.	First	P.	67	5′ 44″	10.465	10.191	53	48	52	53	218	197	214	218	847	2129	1892
,,	,,	S.	70.8				75	79	77	63	327	344	336	275	1282		
12.45 p.m.	Second	P.	65.3	6′ 3″	9.917		65	60	61	65	261	241	245	261	1008	2274	2020
,,	,,	S.	70.2				72	72	72	78	310	310	310	336	1266		
1.8 p.m.	Third	P.	73.5	5′ 12.5″	11.52	11.208	70	63	58	68	317	285	262	307	1171	2693	2392
,,	,,	S.	77.6				74	83	82	80	353	396	391	382	1522		
1.30 p.m.	Fourth	P.	77.5	5′ 25″	11.077		76	70	67	74	362	334	320	353	1369	2784	2475
,,	,,	S.	75.0				80	74	79	74	369	341	364	341	1415		
2.15 p.m.	Fifth	P.	79.5	4′ 49″	12.457	11.925	75	72	71	82	367	352	347	401	1467	3112	2770
,,	,,	S.	78.8				85	90	83	81	412	437	403	393	1645		
2.40 p.m.	Sixth	P.	80.3	5′ 16″	11.392		100	97	80	95	494	479	395	469	1837	3513	3120
,,	,,	S.	77.8				75	96	84	95	359	460	402	455	1676		
2.55 p.m.	Seventh	P.	83.85	4′ 28″	13.433	12.881	100	103	92	85	516	532	475	438	1961	3985	3540
,,	,,	S.	86.6				90	91	104	95	479	485	554	506	2024		
3.15 p.m.	Eighth	P.	86.4	4′ 52″	12.329		95	88	95	93	504	468	504	494	1976	3916	3480
,,	,,	S.	87.3				88	92	98	84	473	494	527	452	1946		

the machinery in the ship.

Top Control Platform.

Opinion is divided as to the relative advantages of top platform control, and the control from the bottom platform, which conforms to the traditional practice in the case of steam machinery and Diesel engines of the four-cycle type. The control from the upper platform was introduced, we believe, by Sulzer Brothers, and is a feature of most of the vessels in which this type of machinery has been installed. In the ship we are describing the arrangement adopted certainly seems the most natural one, and, moreover, it allows of convenient grouping of auxiliaries and auxiliary controls on the intermediate and lower platforms. One objection to the upper platform control is that the space is sometimes rather restricted, but it does not apply in the case of the Dalgoma. The general view looking aft—which we give in Fig. 7 on page 580—shows the main entrance to the engine-room from the upper deck. There is ample space between the main engines where the controls for fuel reversing and manœuvring are placed. At the aft end of the platform is placed the main switchboard, which is slightly raised. It comprises eight main panels with additional panels at the port and starboard sides for the turbo-blower motor switchgear. In the port wing at top platform level there is a well arranged workshop—a view of which is seen in Fig. 4. The machinery includes a lathe, drilling machine and grinding machine by Loudon Brothers, and there is ample bench accommodation. The workshop machines are driven from overhead shafting by means of a 4 horse-power motor. Similar space in the starboard wing is utilised for a 45 brake horse-power two-cylinder Bolinder engine coupled direct to a 30-kilowatt 220-volt generator, by Messrs. Holmes, running at a speed of 340 revolutions per minute. This unit serves as a standby lighting set for harbour use when the main auxiliaries are not required. On a raised platform at the forward end of the engine-room there is a Cochrane boiler, 5ft. 6in. diameter by 13ft. 10in. high, which serves to generate steam for the evaporator and distiller and for general heating purposes. It has a heating surface of 300 square feet, and is fired by the Clyde oil fuel pressure system, the heater and pump unit being conveniently placed on the same platform as the boiler. On the forward bulkhead are placed two groups, each of six seamless steel air storage receivers designed for 1000 lb. pressure and complete with the necessary control valves. In addition to these receivers there are four riveted steel manœuvring air receivers of large capacity for 600 lb. per square inch air pressure. The capacity of these receivers is such as to fulfil amply the Board of Trade requirements for twelve starts on each engine with no compressors running. The various gauges showing the receiver pressures are conveniently placed in relation to the starting platform, so that they are well seen when standing at the main starting position. A sliding indicator also shows the amount of piston cooling water in the gravity tank. Overhead lifting gear is provided for withdrawing pistons when this operation is necessary. One of the most interesting auxiliaries on the ship is a small emergency lighting and compressor set which is placed in a recess at the top of the main engine casing at boat deck level. This plant consists essentially of a four-cylinder Thornycroft 30 brake horse-power paraffin engine direct-coupled to a 16-kilowatt generating set running at a speed of 1000 revolutions per minute. Between the engine and generator there is a spur wheel which drives a Weir three-stage compressor through reduction gearing operated by a hand clutch. The compressor has a capacity of 25 cubic feet of air per minute at a pressure of 1100 lb. per square inch when running at a speed of 420 revolutions per minute. It may be brought into operation by means of a hand lever operating the clutch on the reduction gearing.

Intermediate Platform.

This platform gives access to the auxiliary engine controls, and on the main engines large circular inspection doors enable the pistons, crossheads and piston cooling gear to be examined. Between the two engines is a large scavenge air main with a breeches piece serving the scavenging air trunks of each engine. The amount of air delivered to each engine may be controlled by a balanced disc valve fitted with rubber jointing rings, and, if necessary, the air supply to either engine can be cut off by closing the valve through an outer lever. On the forward bulkhead at intermediate platform level are placed the various motor starters for the auxiliary compressors and pumps, and immediately in front of the ladder leading from the upper platform is a well arranged board of Teledep indicators which show the exact amount of oil present in the various fuel oil bunkers and settling tanks. This installation was supplied by Dobbie, McInnes and Clyde, and the indicators are fitted with the latest form of control valve.

Bottom Platform.

The clear and free space between the main engines and the bottom platform is well illustrated by the view given in Fig. 6 on page 580. Along the forward bulkhead are grouped the various pumping units by Drysdale and Co., Limited, and Carruthers and Co., Limited, of Polmadie. These include the auxiliary and emergency bilge pumps, the sanitary and ballast pumps, and the piston cooling and jacket circulating water pumps and fresh water pumps. Other pumps include two fuel oil transfer pumps by the New Roto-Plunge Company, Limited, and a boiler feed pump by Lamont and Co., Limited. Near the forward corners of the engine-room are placed the manœuvring air compressors. There are two units each of 250 cubic feet per minute capacity delivering air at a final pressure of 1100 lb. per square inch. The machines are of the vertical three-stage type, by Peter Brotherhood, Limited, and are directly driven by 150 brake horse-power Laurence Scott motors. The steam auxiliaries comprise a 15 tons per hour evaporator, by G. and J. Weir, Limited, and a Kirkcaldy distiller giving 3000 gallons of fresh water per twenty-four hours, both taking steam from the Cochrane boiler we have already mentioned. The main engines are fitted with electric turning gear operated by 6 brake horse-power Laurence Scott motors through reduction gearing; Michell type thrust bearings are fitted. The two turbo-blowers are placed in a special compartment in the thrust recess and the main intakes for the blowers are connected to a large rectangular casing with air shafts leading to the upper deck. This arrangement promotes quiet running and ensures an ample supply of fresh cool air. During the trial at which we were present the Brown-Boveri blower was running and a view of this unit is given in Fig. 1. This machine is of the latest design and runs at a speed of 2550 revolutions per minute. The motor is completely enclosed, with forced lubrication and fan ventilation, and although the speed is high we noted the cool running of the plant and the good commutation. The second blower unit is by Reavell and Co., Ipswich, and is driven by an Oerlikon direct-current motor of 235 brake horse-power running at a speed of 3000 revolutions per minute. It is of the single-stage double-ended type, the impeller delivering the compressed air into a central outer casing of volute shape. The air inlets are at either side. An advantage of this arrangement is that the impeller is balanced and thus free from end thrust. In the view we produced in Fig. 2 the Reavell unit is seen assembled for testing, but the outer air inlet casings which connect to the main air intake casing are not in place.

Trial Results.

Throughout the trial the main engines were characterised by their silent and smooth running and their quick response to stopping and starting and manœuvring operations. In Tables I. and II. we reproduce some figures of the speed trials made on the measured mile at Skelmorlie on the 17th inst. The conditions under which the trial was run were as follows:—Draught forward, 10ft. 3½in.; aft, 17ft. 8½in.; mean draught, 14ft.; with a displacement of 6400 tons. Readings taken at 1.50 p.m. and 3 p.m. showed that the load on the auxiliary generator was 700 ampères at 220 volts, corresponding to 154 kilowatts, while the power taken by the Brown-Boveri turbo-blower was 480 ampères at 220 volts, or 105.6 kilowatts. An interesting feature of the run on which we were present was the return trip from Greenock to Prince's Dock, Glasgow. The vessel left the Tail of the Bank at 3.30, and arrived in Glasgow at 6.30, that is, three hours later. During this period two main cylinders on each engine were cut out, and the speed of the engines reduced to 30 revolutions per minute. The manœuvring qualities under these conditions were shown to be quite satisfactory, and we believe this is the first occasion on which the engines have been tested under such conditions. Before the Dalgoma enters service complete consumption trials are to be made, and we hope at a later date to give further details of the results obtained.

This article would not be complete without some mention of the excellent work which has been done by Alexander Stephen and Sons, Limited, in building these first engines of the Stephen-Sulzer type. The whole of both the main and auxiliary engines have, except fuel valves and fuel pumps, been made at the Linthouse works. This new work, involving a high degree of accuracy, has been carried out, along with the turbine and marine engine work going through the shops, and the manner in which it has been done was reflected in the successful bench trials made earlier in the year with both the auxiliary and main engines. It is of further interest to learn that the engines have been started and run by members of the firm's own staff. The success of the Dalgoma should give confidence to other Clyde builders who are at present engaged in the construction of similar and larger units of the same type of engine.

The Rotherham Power Station.

With the growth of steel works and other industries in the Rotherham district, the demand for electric power has greatly increased, and the erection of a new power station to supplement and eventually replace the old station in Rawmarsh-road became necessary. This new station, which will have an ultimate capacity of 125,000 kilowatts, has been constructed under the direction of Mr. Edward Cross, the chief engineer and general manager of the Corporation's electricity supply department. One of the most interesting features of the plant is a 30,000 kilowatt, three-phase, 6600-volt, 50-cycle turbo-generator built by the British Thomson-Houston Company, which was started up by the Prince of Wales on Monday last, May 28th. The turbine is a Curtis machine with fourteen stages, the first stage wheel having two rows of blades, and the remaining thirteen wheels one row of blades each. The generator, which is of the totally enclosed air-cooled type, is directly coupled to the turbine by a flexible claw coupling. Complete with the generator the set weighs about 300 tons, and occupies a floor space of 47ft. by 20ft. 6in. by 12ft. above the floor level. Steam is admitted to the machine at a pressure of 200 lb. per square inch and at a superheat of 200 deg. Fah. With an average vacuum of 28½in., the full load steam consumption is 324,000 lb. per hour, and at the most economical load of 25,000 kilowatts, 277,500 lb. per hour. The governor, which maintains the speed of the turbine constant within 3 per cent. from no load to 30,000 kilowatts, is fitted with hand and electrical adjustments by means of which the speed can be varied within the range of 5 per cent. above or below the normal speed of 1500 revolutions per minute. The two main stop valves are arranged to act as emergency valves and to shut off the steam if the speed rises 10 per cent. above the normal value. Hand and electrical trip gear is also provided. The oil for operating the servo-motor, and for the general lubrication of the machine, is supplied under pressure by an oil pump which is driven from an extension of the turbine shaft through a worm and worm wheel. An auxiliary steam-driven pump is also fitted and is used when starting and stopping the machine, in order to maintain a liberal supply of oil at the bearings.

The alternator is designed to give a maximum continuous output of 40,000 kilowatts at a power factor of .75, which, of course, corresponds to 30,000 kilowatts. The stator winding, which is of the bar type, is arranged in two layers in open slots, which have openings arranged to accommodate dovetail keys made of impregnated hard wood, which hold the windings securely in position, whilst the end portions of the windings are supported by deep-section bronze rings insulated and mounted on brackets on the end flanges. The rotor is of the cylindrical non-salient pole type, with distributed windings, and is designed so that its critical speed is below the normal running speed—i.e., approximately 1000 revolutions per minute—and in order to allow of running through this speed with safety and freedom from excessive vibration, the shaft journal at the exciter end is carried in a special "slip" bearing, which is arranged to permit of a small radial play between friction collars. The radial movement thus allowed when running through the critical speed and the resulting work which is done on the friction collars, completely obviates any tendency for the shaft to whip. In accordance with the maker's standard practice the alternator has been made self-ventilating, so as to avoid the use of external fans.

An interesting test, consisting of subjecting the machine to a sudden single-phase short circuit when running excited at full voltage, was made at the Rotherham Corporation's electricity works before the machine was finally put into service. At the moment of short circuit the current rose to a maximum root mean square value of 18,200 ampères, or 5.2 times the normal rated current of the machine. A maximum short circuit current of only 5.2 times the normal full load current is a considerably lower value than is usually obtained with turbo-alternators.

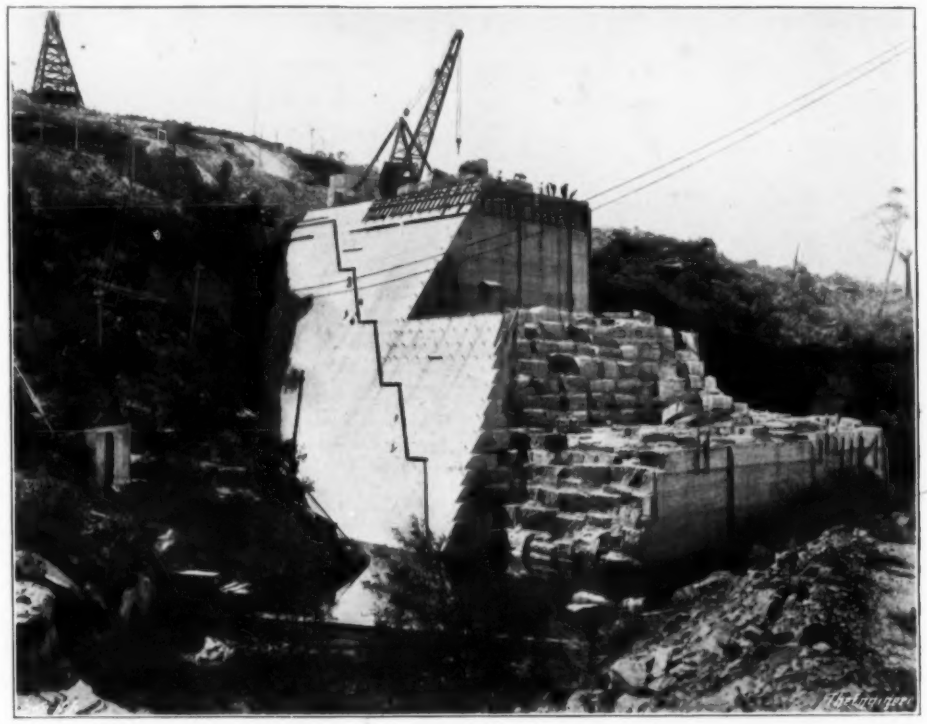
Eventually, there will be four switchgear sections with bus-bar reactances between them, but at present only two sections are installed, one of which includes the control gear for two 1250-kilowatt Parsons' turbo-generators, and the other for the 30,000-kilowatt turbo-generator built by the British Thomson-Houston Company. The auxiliary plant is supplied by two of the latter firms' 1500-kilowatt rotary converters running at a speed of 500 revolutions per minute, and converting 6600-volt three-phase current into 480-520-volt direct current. An inter-connector between the old station and the new permits an interchange of 5000 kilowatts between the two, so that continuity of supply is assured in the event of one of the stations being shut down. With a view to ensuring further continuity of supply, all the high-tension switchgear is provided with duplicate bus-bars. The high-tension B.T.H. switchgear is housed in an annexe to the generating station, and occupies three floors, the low-tension control panels being installed in a separate room at one end of the annexe. The first floor of the annexe contains the oil break switches, the ground floor the bus-bars, isolating switches and instrument transformers; whilst the basement is reserved for bus-bar reactances with their switchgear and for the generator neutral point earthing resistances and the isolating switch pedestals. The whole of the high-tension switchgear is of the cellular type, with phase barriers, so that any fault which may occur on the switchgear will be confined to the particular phase and piece of apparatus concerned. Duplicate bus-bars are provided, one set being placed on each side of the 9in. concrete wall, which runs the whole length of the ground floor and divides it into four compartments.

The difficulty which is experienced in this country in giving a supply of electricity to farmers on account of the scattered nature of the load, is experienced by electrical engineers in other countries also. As the *Electrical World* points out in a recent issue, the labour-saving problem is as acute in the agricultural industry as in other industries, but whereas electricity has been able to help the latter, it has not yet been possible to bring it to the door of the farmer economically on account of the small use of energy on the farm compared with the cost of the service. If the problem can be solved and the use of electricity on the farm can be properly developed, American "agricultural engineers" believe that the result will be a real revolution in agricultural production methods. With labour costs constantly rising and living conditions on an ascending plane, the farmer, like the manufacturer, must "increase the productive ability of the human worker by taking from him the tasks that mechanical equipment can accomplish much more economically, so that he can devote his time to keeping machines at work."

SYDNEY WATER SUPPLY—THE CORDEAUX AND AVON DAMS

MR. E. M. DE BURGH, M. INST. C.E., SYDNEY, N.S.W., ENGINEER

CORDEAUX DAM—GENERAL VIEW FROM LEFT BANK, 14th MARCH, 1921



CORDEAUX DAM—DOWNSTREAM FACE OF RIGHT ABUTMENT, 18th OCTOBER, 1922

GENERAL VIEW OF THE SITE OF THE AVON DAM LOOKING DOWNSTREAM [illegible]

GENERAL VIEW OF THE SITE OF THE AVON DAM, LOOKING DOWNSTREAM, 6th NOVEMBER, 19

EXCAVATION FOR THE FOUNDATIONS OF THE AVON DAM, 19th OCTOBER, 1922

QUARRYING FOR THE CORDEAUX DAM

QUARRYING FOR THE AVON DAM

Railway Matters.

THE appointment, held since the office was created, of Mr. Norris G. Bell, as Commissioner of the Railways of the Australian Commonwealth, has been extended for a further six months.

ALL opposition to the application for an extension of time for the construction of the Wimbledon and Sutton Railway having been withdrawn, the Bill has been passed for third reading in the House of Commons.

A RECENT serious fatal tramway accident near Leeds has led to the suggestion that sand drags might be used on tramways as on railways to intercept cars that cannot be stopped when descending steep gradients, and those which run back when ascending.

THE railway companies have conceded, as from the 1st inst., to all persons under eighteen years of age in receipt of salary, wages or other monetary allowance not exceeding 18s. per week, the privilege now enjoyed by scholars, students and apprentices under eighteen years of age, of purchasing season tickets at one-half the ordinary rates.

OUR notice of the 25th ult., as to the Institute of Transport Sheffield Congress of June 14th, 15th and 16th, included a railway paper, the title and author of which had not been named. It is now announced that Mr. J. A. Jenkinson, district traffic manager, London and North-Eastern Railway, Grimsby Docks, will read a paper on "The Railway Requirements of a Large Industrial Area."

PROVIDED that the Ministry of Transport inspection yesterday was satisfactory, the Welsh Highlands Railway is to be opened for public traffic to-day (Friday). The line commences at Dinas Junction on the London, Midland and Scottish Company's Carnarvon–Afar Wen line and runs through Snowdonia to Portmadoc, a distance of 21 miles. At Portmadoc a connection is made with the Festiniog Light Railway, 14 miles in length.

IN several cases of derailments and collisions on the East Coast route the vehicles have kept in line, with a consequent reduction in the personal and material damage, owing to the use of the Pullman vestibule and the Buckeye coupling. It is, therefore, of no little interest to note that the latter safety appliance has been adopted on the Great Western. The company's new restaurant cars are to have the kitchen and pantry in the centre, following the practice of the London and South-Western. It makes a better riding coach and gives quicker service.

A PROVISIONAL agreement has been signed for the amalgamation of the Great Southern and Western and the Midland Great Western Railways of Ireland. It is also expected that the inclusion of the Dublin and South-Eastern will soon be announced. The only big company then outstanding would be the Great Northern of Ireland. There are two difficulties mainly in the way of its amalgamation with the three companies named. One is that it operates in the "six counties" area as well as in the Free State, and the second obstacle is that it is mainly financed in Belfast and, therefore, outside the Free State.

TO-DAY and henceforward, the Northern of France and the Belgian State Railways will run a train daily each way between Paris and Brussels, without any stop for either Customs or locomotive purposes. The distance is 193.1 miles, and will be covered in 3 h. 45 min. As there are no water troughs the tenders used will contain 31 cubic metres of water. This is by far the longest non-stop run ever made on the Continent. It was exceeded during the war for length of run without a change of engine by Paris-Dijon, 195.6 miles, but then there was a stop at Laroche for water. The French summer-time tables show increased services and acceleration.

GALWAY as a Transatlantic port, to which the late Mr. Robert Worthington, of Dublin, devoted so much attention, has again become a live question. A deputation recently waited upon the Free State Minister of Industry and Commerce when the spokesman for the Midland Great Western Railway said that there was a line from Galway straight through to Dublin which, with little expenditure of capital, would be able to deal with any traffic that might result for the next fifty years. It seems to us that in the development of Galway as a Transatlantic port there is an excellent opening for the profitable employment of Irish capital.

THE cost-of-living figures announced last week are likely to be very unpalatable to the railway men. The agreement between the men's unions and the companies is that for every five points change in the cost of living there shall be 1s. change in the men's pay, except that any fall shall not be below a certain minimum. A subsequent agreement provides that the increases made in June, 1920, by the National Wages Board, should be withdrawn in the same proportion. The last change was made in July, 1922, when the cost of living was eighty points above 1914. In September, December and March last the change was not as much as five points, and so the rates of pay were unaltered. As the cost has now fallen to seventy points, there seems to be a likelihood of those men whose minimum has not been reached having to lose 4s. per week.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the three months ended March 31st, 1923, was as follows, the corresponding figures for 1922 and 1921 being added in brackets:—Locomotives, £839,744 (£2,111,946, £1,798,069); rails, £470,220 (£1,009,336, £1,046,264); carriages, £328,356, (£470,992, £322,396); wagons, £629,725 (£1,480,961, £1,616,059); wheels and axles, £243,353 (£381,792, £537,141); tires and axles, £104,191 (£169,095, £436,566); chairs and metal sleepers, £156,747 (£645,221, £519,895); miscellaneous permanent way, £265,882 (£459,290, £831,136); total permanent way, £1,311,736 (£2,733,351, £3,487,113). The weight of the rails exported was 54,996 tons (94,943 tons, 44,616 tons), and of the chairs and metal sleepers, 13,817 tons (43,627 tons, 22,401 tons). Locomotives to the value of £149,639, and rails to the value of £65,715 were shipped to India during March, 1923, and rails to the value of £23,342 to Australia, and of £22,821 to South Africa.

Notes and Memoranda.

ACCORDING to Dr. Wagner, muscovite, in plates and books up to 8in. in diameter, occurs in veins and lenticular bodies of pegmatite and pegmatic quartz to the north and south-east of Klein Kharas in Great Namaqualand, South-West Africa. A fair amount of exploratory work was done on the deposits, but the mica proved to be too badly flawed to be of any commercial value. The same authority states that he has seen fine specimens of molybdenite from a pegmatite vein to the south of Usakos, and also from a deposit said to exist in the Kuiseb Valley, near Walvis Bay.

IN Istria, according to an account in the house journal of Mavor and Coulson, there is a coal mine about 4 miles from the sea, which is drained and ventilated by an adit driven in from the coast, that has a rise of some 300 yards. The seam is 4ft. thick, and is worked on the long wall system, but hardly any timbering is required. The most singular feature of this colliery is, however, the occurrence of vast subterranean caverns, which at several places have abruptly stopped the workings. The largest of these caverns is over 2000ft. from top to bottom, 1300ft. of this being beneath sea level, and its volume is estimated to be nearly 2½ million cubic yards.

UNBLEACHED and unsized warp yarn, treated with various waterproofing materials, was tested in America to determine its tensile strength and then exposed to the weather. At the end of one year the treated yarn in most cases was stronger than the untreated yarn similarly exposed, but weaker than the treated yarn before being exposed. Yarn subjected to three treatments containing asphalt showed no material loss in tensile strength after being exposed. Raw drying oils caused more deterioration than the same oils previously boiled with metallic driers. In most cases, semi-drying and non-drying oils caused as much deterioration as raw-drying oils. The addition of burnt umber to a drying-oil treatment had a decided preservative effect.

READING a paper before the International Acetylene Association at Chicago, Mr. N. E. Wagner said that his company, the Prairie Pipe Line Company, had welded a number of river crossings where considerable loss and inconvenience had been caused by the breaking of couplings. For river crossings much heavier pipe was used than for ordinary line work. In many instances pipe laid upon the beds of the stream, even when secured with heavy clamps, will be undermined by the action of water on sand and left suspended. As a result, the constant vibration of the water against the pipe will wear out the threads of any coupling, whereas the welded line withstands this water action. Thus far, no difficulty has been experienced with welded river crossings.

THE porosity of wood makes it susceptible to marked changes by changes in moisture content. Investigations have been made in America to determine the best protecting coatings. Linseed oil, though highly valued, was found to be of little use. The best coating is the aluminium leaf which was developed in the Forest Products Laboratory as a coating for aeroplane propellers, but this can be applied only to large unbroken surfaces. Asphalt and pitch paints are efficient, but the colour is often objectionable. No way has yet been found to apply over these paints lighter coloured materials. Cellulose lacquers have some advantages. For temporary protection vaseline smeared over varnish or a heavy coat of paraffin is satisfactory. These cannot, however, be used on surfaces subject to wear.

IN the course of a "Review of Turbine Troubles and their Causes," read before the North-East Coast Institution of Engineers and Shipbuilders, by Professor A. L. Mellanby and Mr. W. Kerr, the authors said that it is a fairly common belief—principally on the guidance of theory—that there is but little end thrust on impulse turbines. Actually, however, the thrust block is necessary for more than the maintenance of the rotor position. The balance holes usually provided in the discs offer indirect evidence of this. If the indications of theory are blindly accepted, there may, or may not, be trouble—it depends on the thrust block. In a series of similar impulse machines no balance holes were provided, and multi-collar thrusts were fitted. There were several cases of thrust-block troubles indicating excessive end forces, but when holes were cut in the discs the trouble ceased.

IN the opinion of Mr. G. Stevenson Taylor, the Senior Engineering Inspector of the Home Office, an explosion which occurred recently in an oxygen compressor at Erith was to be accounted for by an ignition explosion due to the presence of combustible material in the oxygen, and this must have been due either to hydrogen or derived from the soap used in the lubricating solution. He gave it as his opinion that the ignition was not due to hydrogen, and that the combustible material was derived from the soap which was used in distilled water for lubricating purposes, through chemical action on the brass fittings and parts of the compressor. In the presence of water, this would produce "a copper soap," which would break down much more readily than an alkaline soap. It would break down into organic vapours at certain temperatures, and these mingling with the oxygen would cause the explosion.

A RECENT invention referred to in the *Acetylene and Welding Journal*, relates to a process for the autogenous welding of nickel and alloys containing a high percentage of nickel. Up to the present, the welding of this metal and alloys with high nickel content has been found to be impracticable, owing mainly to the occlusion of gases during the welding operation. According to the invention, occlusion is prevented, and a satisfactory weld produced, by welding and subsequently cooling the nickel or alloy in the presence of carbon or a carbonaceous material or compound, which, when heated to a high temperature during the welding process, produces a reducing atmosphere of a higher power of occlusion than the metal itself, and therefore during cooling occludes the deleterious gases which would be occluded by the nickel or nickel alloy. The atmosphere maintained around the metal during cooling is, as a result of the occlusion by the carbon, inert.

Miscellanea.

AN unusual form of screw propeller, which has recently been cast on the Clyde, in Bull's metal, has five blades. It is 18ft. 6in. in diameter and weighs 9¾ tons.

THE Ka-Ka-Ka Falls, on the Quinze River in Canada, are to be utilised by the Northern Ontario Light and Power Company, for the development of some 90,000 horse-power.

THE plant built during the war by the American Cyanamide Company at Niagara Falls, which is capable of producing 40,000 tons of fixed nitrogen yearly, has been standing ever since it was tested; but several offers are said to have now been made for it.

IN the Works Department at Devonport Dockyard, states the *Naval and Military Record*, a small number of men have received notices of discharge, but this is not due to any change of Admiralty policy with regard to the yard. In this department it is the practice to enter men and discharge them as work fluctuates.

THE attempt to extract oil from shale in New South Wales by means of firing it in the ground and collecting the oil thus distilled, has been abandoned. The high cost of Australian labour and the low price of imported oil are given as the principal reasons why these remarkably rich oil shales cannot be worked at a profit.

EXPERIENCE with powdered coal as fuel for some reheating furnaces at the works of Edgar Allen and Co. shows that taking all expenses into consideration, *i.e.*, the slack, the motor, fitters' wages, wages for cleaning flues, and interest on original cost of the machine, the result of using the pulveriser has been to reduce the cost of heating ingots by one half.

THE solution of the fuel problem of the Province of Ontario through the erection of a Government-owned peat plant is made in a report of a committee of the Provincial Legislature. The committee, which has completed researches occupying seven years, expresses itself as strongly of the opinion that the manufacture of fuel from Ontario's peat beds is a commercial possibility and should be considered.

ACCORDING to the *Electrician* the work of laying the 60 miles of cables required for the telephone system in the new Delhi will be commenced shortly. The exchange at the new city will be designed for a maximum capacity of 3000 subscribers on and up to the date of the automatic system being installed. The initial capacity will be for 1500 subscribers. Later it is intended to provide a similar exchange for Delhi itself.

THE manner in which road transport is giving the *coup de grâce* to canals the ruin of which had not been effected by railway competition, is referred to in *The Roadmaker*. It was stated in evidence in the House of Lords that goods carried from Manchester to Sowerby Bridge by road were delivered in 2½ hours against two and a-half days, which was the time taken for the journey by canal. Besides this the cost of road transport is lower than that for canal or railway-borne traffic.

THE Russian authorities have decided to erect a wireless station on the Island of Nova Zembla. The station is to be so equipped that it will be able to hold communication with Archangel and other stations in North Russia and Siberia. Particularly will it give attention to the weather conditions in the Kara Sea. The station is also to serve in a scientific direction, and the *personnel* is to include, in addition to the wireless experts and meteorologists, a geolist and a zoologist.

CROWBOROUGH must now be added to the number of those places where electricity and gas is supplied by the same undertaking. Powers for this purpose were obtained by the Crowborough Gas and Electricity Company in 1913, but it was not until last year that Sir Charles Bright and Partners were called in as consulting engineers and the work definitely put in hand. A scheme suitable for such an area was prepared by Mr. A. Hugh Seabrook, and the supply was formally inaugurated by the Hon. Osmund Scott on May 16th.

THE feeling of members of the House of Commons who have discussed the projected Transatlantic service of aeroplanes is in favour of Plymouth as the English coast station instead of Southampton, as was proposed at first. The route will thus be London, Plymouth, Lisbon, the Azores, Halifax, and New York. It is intended to use different types of aeroplanes on the different stages of the journey, according to the length of flight entailed. It is stated that the promoters have sufficient funds to arrange for an experimental trip, and they do not intend to apply for money either to the public or the Government until it has been demonstrated that the scheme is in every way practicable.

THE number of locks between Rouen and Paris, nine in all, not only occasion considerable loss of time in navigation, which is estimated at two hours for each lock, but also necessitate higher freight rates. It is estimated that freight rates are about the same for the 780 kilom. between Antwerp and Strasbourg, as they are for the 250 kilom. between Rouen and Paris. M. Le Troocquer, Minister of Public Works, has instructed the river navigation and hydraulic services to study a report which has been drawn up with the view of accelerating transport and reducing freight rates by abolishing a certain number of these locks. The first lock which it is suggested should be done away with is the Martot lock and weir, above Rouen. It would not be possible to do without the locks at Suresnes, Bougival and Andrezy, all near Paris, as the working of the Paris sewage system is based on the present level of the water; but it would be possible to do without those of Meulan and Port Villez, by increasing the height of the weir and lock immediately above them. This change would have the additional advantage of increasing the fall of water, thus providing electric power for a considerable district. Applications for concessions for the working of such falls have already been received, and it seems likely that if these are granted, the concessionnaires will be asked to take over part of the expenditure in connection with these improvements.

THE MOTOR CARGO SHIP DALGOMA

ALEXANDER STEPHEN AND SON, LIMITED, LINTHOUSE, GLASGOW, BUILDERS AND ENGINEERS

(For description see page 576)

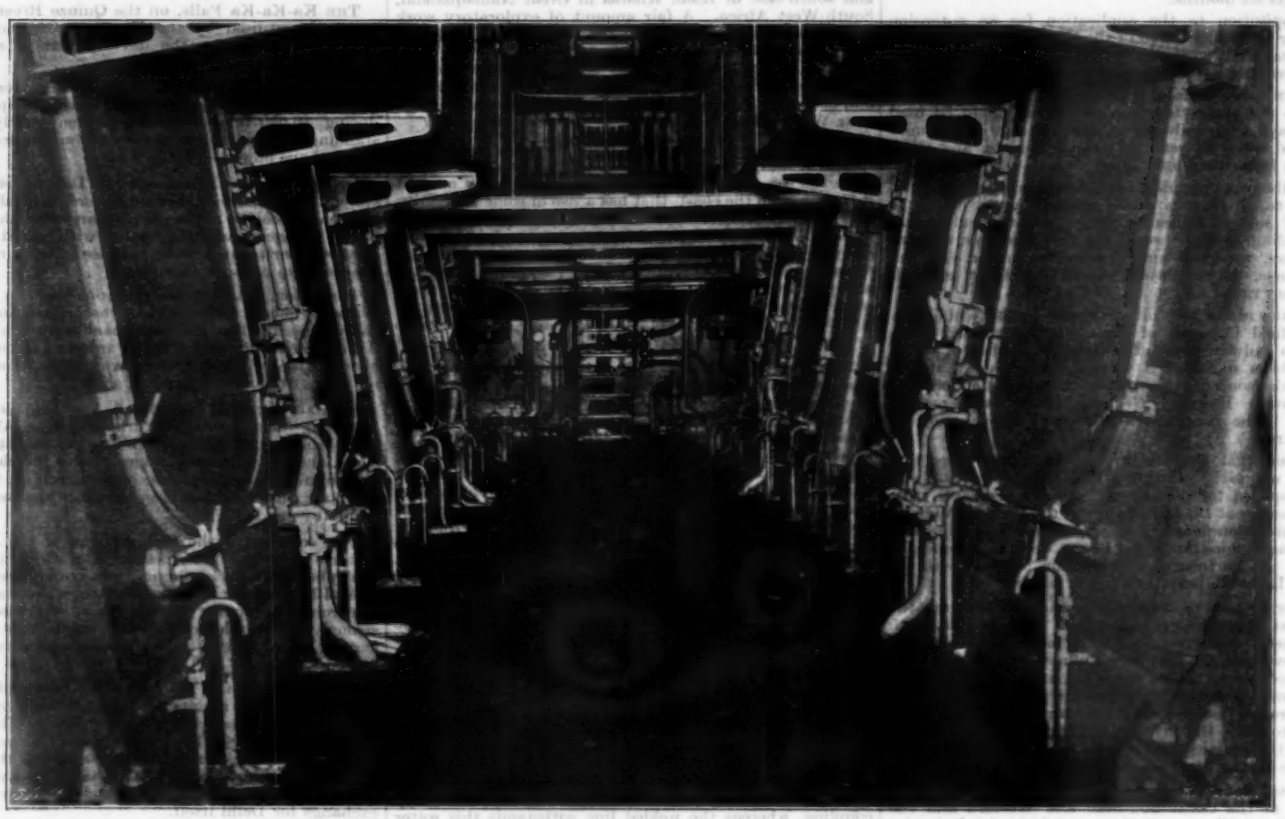


FIG. 6—VIEW ALONG BOTTOM PLATFORM

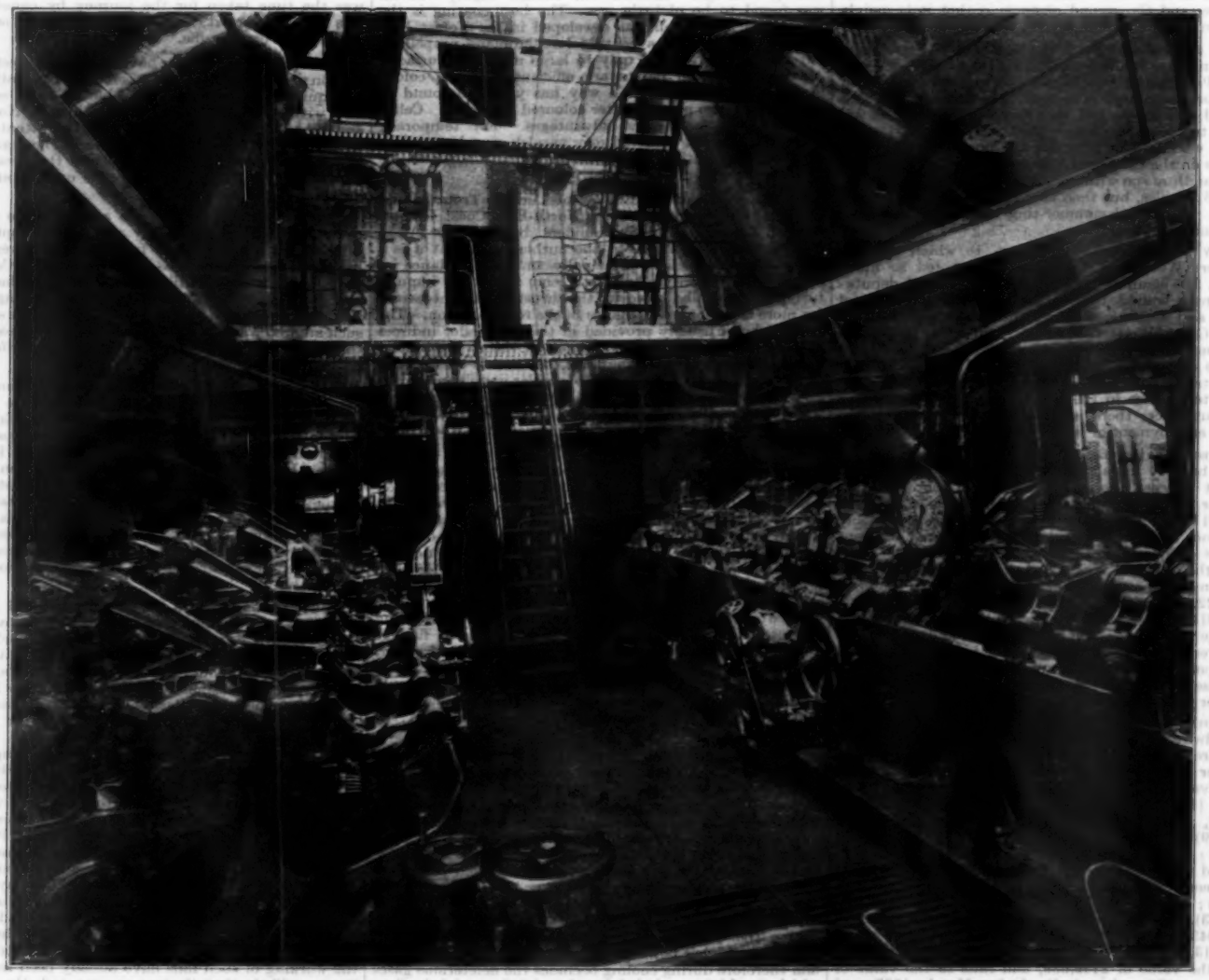


FIG. 7—TOP CONTROL PLATFORM, LOOKING AFT

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TWO-PAGE SUPPLEMENT—SYDNEY WATER SUPPLY—THE CORDEAUX AND AVON DAMS.

THE ENGINEER.

JUNE 1, 1923.

Newton and Einstein.

IT has recently been remarked by someone, obviously an ardent relativitist, that to the contemporaries of Newton, the Newtonian philosophy must have appeared as abstruse and involved as the Einstein doctrine does to most people to-day. Had Einstein come first, we are assured, the teachings of a modern Newton would have been found by many just as incomprehensible and irrational as they now find the theory of relativity. Once we have succeeded in raising ourselves to the new outlook, the old philosophy, we are told, will appear clearly in its true colours as incomplete, crude and wholly unsatisfactory. It can be admitted at once that our minds are now so set in the mould left for them by Newton that few of us can restore to them sufficient plasticity to enable us to judge this matter properly. It is exceedingly difficult, for instance, to realise that the existence of a "true even-flowing time which is unique and universal," the most fundamental postulate of the Newtonian philosophy, is just as much an unsupported assumption as that involved in the relativitists' conception of a universe in which time and space are not dissociated from each other. It is of little assistance to argue that, whereas the classical idea of true time is of very much older origin than Newton, and appears to be one of our most primitive impressions, the relativitistic conception has only recently been evolved, and is the result of highly specialised mathematical reasoning. In science, primitive instinct or impression must never be allowed to prevail against the deductions of logical reasoning if the teachings of the two are, as in this matter, in opposition. Nevertheless, while we do not challenge the mathematical logic of the theory of relativity and are prepared to yield to it to that extent in the contest between the two philosophies, we still feel that on the grounds of plain reasonableness, simplicity, convenience and necessity, everything is on the side of Newton.

It appears to be necessary to emphasise the fact that the theory of relativity is purely a mathematical theory, and that only through the gateway of mathematics may we approach to anything like a proper understanding of it. We cannot ascend to the new plane by way of the ordinary processes of direct thought. As well might we try to reach it without mathematics as attain heaven in the fleshly body with fleshly instruments. In saying so, we are neither seeking to exalt the power of mathematics nor uttering a cry of despair, but are merely trying to warn those who may have been led by the numerous popular writings on the subject to believe that the theory can be expounded in simple terms. Let anyone in doubt upon this point consult a newly published work by one who is probably the leading British protagonist of the new philosophy, "The Mathematical Theory of Relativity," by Professor Eddington, of Cambridge. Although he may be unable to follow completely the learned author's arguments and expositions, he will, we feel sure, derive from a study of the book the sound and justified conviction that the modern theory of relativity is a box of tricks evolved from the inner consciousness of mathematicians, and is only to be comprehended fully by those possessing the necessary key. In this respect, the new is in very sharp contrast with the old philosophy. Newton's laws and conceptions can all be expressed in plain words. If in some respects they are, fundamentally, verbal expressions of mathematical equations, their simplicity and directness are such that their full meaning can readily be seized by all, even by those who possess no mathematical knowledge. To enforce the abandonment of the old mechanics and insist upon the adoption of the new, would, we are convinced, be to shut the gates of physical science on the very big majority of mankind, and to concentrate the understanding of this branch of natural knowledge in the minds of a few mathematical specialists. So far the relativitists have signally failed to demonstrate that their theory makes one iota of difference in anything that really affects the welfare of mankind. But even though they could do so, we see not the slightest prospect of Einstein ever replacing Newton in our schools and universities. It is not enough to establish the pure truth of the theory of relativity and the inherent falsity of the classical mechanics. Newton's laws may be only approximations to the truth, but their simplicity, combined with the fact that millions of observations confirm them well within the limits of experimental error, outweighs any consideration of pure and absolute truth. Even in the most profound application of physical theory simplification is sought by resort to approximations, and indeed in very many cases theoretical treatment at all is rendered possible only by such a course—consider, for example, the theory of the pendulum, the gyroscope and a hundred instances in molecular and astro-physics. So long as that condition prevails, it would be illogical and pedantic to insist upon the abandonment of our present fundamental physical outlook because it was demonstrably itself but approximately correct. On the score of its necessity, the case against the new philosophy is at least as strong as that based on the grounds of its reasonableness, simplicity and convenience. It was evolved as a means of accounting for the failure of the Michelson-Morley experiment to detect the drift of the ether, and to do so set out by abolishing the ether altogether. Actually, recent refined experiments have detected a quantity corresponding to ether drift, but even if we ignore this fact, it yet remains to be established that the existence of the ether is necessary to the Newtonian system of mechanics or that the absence of ether drift cannot be satisfactorily accounted for except by adopting another system, and, in particular, that promulgated by Einstein. Only in one other respect can it be truly said that experimental observation affords any basis for suggesting the necessity of a change in our fundamental conceptions. That instance is not to be found in the alleged bending of the stellar light rays when passing near the sun, of which we have heard so much, for without Einstein's deduction from his theory that they would bend, the deflection would never have been noticed, or, if observed, would have been accounted for as a simple error, and would never by itself have been made the basis of a revolutionary new philosophy. In the movement of the perihelion of Mercury the circumstances are certainly otherwise, for here we have a case of discrepancy between theory and observation which for long has puzzled astronomers, and which can be all but completely accounted for by Einstein's theory. Let the relativitists take what joy they can from the success which their calculations have met with in this matter. The satisfaction of being able to explain this small discrepancy in the movement of the planet Mercury is certainly not sufficient to reconcile us to the concomitant necessity of introducing almost prohibitive complexity into our understanding of all the conceptions of physics other than pure number, action, entropy and a few minor items.

Those who support the theory of relativity assume, or seem to assume, with surprising readiness that if observational results are not in agreement with the theoretical, as determined by Newtonian mechanics, it is the fault of our having chosen an erroneous philosophy. To most plain-thinking men, it would first occur to suspect the accuracy of the observations, for while human fallibility and instrumental inaccuracy remain as

they are, the possibility of error in our readings must always be the first consideration to influence the deductions made from them. If, however, we are satisfied that any observational error is not sufficient to account for the discrepancy, the second alternative has to be investigated, namely, that our interpretation of the theory is incorrect. Not until this aspect has been fully studied are we logically justified in doubting the foundations on which our theory rests. From this standpoint, very much might be said regarding the attack delivered on Newton by the modern mathematicians. It opens the prospect of a counter-attack along the lines that even modern mathematicians are incapable of interpreting fully and accurately all the implications of the Newtonian laws. A more suitable instance could hardly be provided than is at hand in the case of the planet Mercury, the "explanation" of the movements of which is the outstanding item of the relativitists' practical achievements. Were these movements the result of the inter-attraction of the sun and Mercury alone, the Newtonian system would be capable of forecasting them accurately. Actually, the other planets are concerned in the matter, but even though we add only a second, the problem of predicting the movements of Mercury according to Newton's laws would still be beyond the power of mathematicians to solve otherwise than by approximation. On this score it must be noted that while the three-body problem on the old system has not yet been solved, on the new even the two-body problem still challenges the solution of the relativitists. The last excuse for urging a change of outlook thus seems to be torn from those who would bring about a general revision of our fundamental physical beliefs. Could it be shown that by so changing we could overcome some of the problems which at present fail to yield to treatment, a fairly good reason of a practical nature would thereby be afforded for making the change. As it is, the alteration, in the instance specified at least, actually produces retrogression, in that it makes, for the time being at any rate, insoluble that which is now soluble. The possibilities of the Newtonian mechanics are yet far from exhausted. The implications of the simple, straightforward laws which that system of philosophy gave us are still remotely understood in all their bearings. The field provided within the orthodox fold even now gives scope for the highest and most original work of the ablest mathematician. Not until these possibilities, implications and opportunities have been drained dry and found wanting, need we seek a fresh outlook. Not until then, we think, need we regard the theory of relativity otherwise than as a mathematical *tour de force*.

The Diffusion of Knowledge.

THE day is not so very far behind us when practical engineers were, in all seriousness, doubtful about the value of a scientific college training for engineers. It was felt by many in those days that the applicability of what could be taught in a science college to practical engineering problems was too remote, and that the student thus taught would be given a wrong standpoint—the standpoint of "theory" rather than that of "practice." There are still individuals, and possibly even whole branches of our profession, who, while not perhaps very openly advocating such an attitude, still covertly long for the "good old days" of "practical men." The great growth of our engineering colleges, however, and the preponderating place which their graduates now occupy in the profession, are ample evidence that the value of a scientific training was not over-rated, while, on the other hand, the increasingly scientific character of our technique makes training, except in a properly organised, staffed and equipped college, almost impossible.

Corresponding with this inevitable development on the side of the engineers, we have a corresponding improvement in the attitude of the majority of men of science towards engineering. There are still some who look down upon what they term "applied" science as a minor and lower branch, and we can perhaps well afford to forgive this slightly "superior" attitude in view of their own enthusiastic and often devoted service to the advancement of pure knowledge. On the whole, however, there is a far better mutual understanding and appreciation. Even if we regard the advancement of knowledge as the main object of scientific research, yet the fact that scientific progress can and does confer immense benefits on mankind, largely through the intervention of the engineer, is very fully appreciated—indeed, to many minds, it is the real and only justification for the expenditure of much time and money on scientific research. At all events, in the mind of the "scientific engineer," if we may so designate the more academic members of our profession, there can be no doubt as to the aim of his work and of his teaching. At times, however, we fear that there may be a little error in the estimation of its scope. In these days of increasingly scientific technique, of ever-growing demands upon engineering products of every kind, there can be, to our mind, no possible doubt that a sound training in the general facts and principles of science is essential to the embryo engineer. Further, there is a large amount of specialised technical and scientific knowledge connected with engineering, and, in a sense, serving as its basis, which can only be properly taught and investigated in colleges or other scientific institutions. Yet, when all is said and done, the graduate of the finest engineering college, whether here or abroad, can never be a ready-made engineer. It is for just that reason that we appreciate the attitude adopted by the University of Cambridge, which has a splendid school of "mechanical sciences," but does not grant degrees in "engineering." The fact is that a college education can at best but lay the foundations of engineering knowledge, and upon those foundations the young graduate must proceed to build up a true knowledge of whatever branch of engineering he may enter. In the first place, engineering practice entails contact with the human element in forms which cannot be studied otherwise than by actual experience. The best of trainings can do no more than fit the graduate to gain this experience as rapidly and easily as possible; but it can only be completed by a long course of work in the "shops." Further, the study of scientific problems, or the scientific treatment of most engineering problems can, as a rule, be carried out only by the aid of a number of simplifying assumptions, and it is a matter for the careful judgment of the practical engineer to determine how far, in any given instance, these assumptions may be justified. While we cannot, in these days, rely upon any man's "instinct" for correct design, in lieu of calculations based on scientific methods, yet practical judgment must be used at every turn where the results of calculations are to be employed. There are, indeed, numerous cases in the experience of every engineer, where conditions are so complex that it becomes hopeless to disentangle them sufficiently to permit the application of simple scientific principles, and there judgment—based on experience and on that "insight" which undeniably some men possess—is the only guide. We cannot doubt the value of scientific training to any engineer, but we should like to feel sure that the training was scientific enough to ensure that the young graduate realised that even if he knew all that the best of colleges could teach him, he would yet be far from "knowing it all" as regards engineering practice. We should, furthermore, like to feel more sure than we do that the foundations are being well and truly made, that there is no jerry-building in the production of our young engineers. We have, at times, an uneasy feeling that too much is being attempted and that many of our young engineers have a superficial knowledge of a great many things, but a sure knowledge of few.

We fear that many engineers, immersed in the busy practice of their profession, do not fully appreciate how much scientific men and institutions, and we may justly add, their technical Press, have done and are daily doing for them and their profession. The field covered by scientific and engineering activities is so vast that it is difficult for an individual to realise more than a small fraction of what is being done, whether it be in regard to the study of materials and their behaviour under the more exacting conditions which apply to modern practice, or in regard to such matters as accuracy of measurement—which has a very profound bearing upon modern tendencies towards interchangeability and mass production. The further we consider the matter, the more fully we must realise that science and engineering are most intimately interwoven. It follows that closer personal contact between workers in the two professions, and better mutual understanding, is eminently desirable. Opportunities for such contact and understanding are by no means lacking at the present time, but every possible means for increasing them is to be most cordially welcomed. The institutions, the booksellers and the Press are doing their best, and yet in a measure they are defeating their objects by the intensity of their efforts. What is more common than to hear an engineer say, "I have not had time to read so and so; there is so much to be read"—which means generally that he reads nothing at all. "Proceedings" are collected and filed, books are bought but only glanced at, technical newspapers are skimmed. We do not hesitate to say that amongst the general body of engineers there is far less real careful reading than there was thirty years ago, when there were few societies and only two or three engineering papers. At our technical meetings papers are perforce presented in abstract. How many of the members that attend ever read and digest them? Yet if we admit that it is in the highest degree desirable that engineers should know something of developments, and particularly scientific developments, outside their own specialised objectives, more must be done. What is the best way of doing it?

French Policy and British Trade.

WHATEVER may be the opinion expressed upon the various economic factors which affect trade, there is certainly a general idea that no readjustment of commerce is possible so long as business is paralysed by the occupation of the Ruhr. It is true that a large amount of trade has been diverted to this country for the time being, but it does not compensate for the lack of financial stability which shuts out so many markets to British goods, and it may be assumed that if the Ruhr affair were settled satisfactorily the ground would be cleared for a general trade reconstruction. Developments that have taken place in the occupied territory during the past month lead to the hope that, with British aid, a way will be found out of the difficulty. As soon as reparations are definitely settled, there should be a stabilisation of finance, accompanied by improved credits and fewer discrepancies in money values, and although it will be a long time before living costs and wages adjust themselves to the new state of things, the situation will yet have so far improved as to provide elements for a trade recovery. Nevertheless, the question of living costs and wages abroad will depend largely upon the commercial policy to be adopted by the different countries. Unfortunately, the tendency everywhere is to protect industries created since the war, and in France the situation is complicated by the conflicting interests of new industries, which depend entirely upon the home market, and of those essentially French industries that need every facility for exporting their goods. For that reason, the French will have nothing more to do with general treaties of commerce. They have long been seeking to enter into short-period commercial arrangements with different countries, and have succeeded, after interminable negotiations, in settling upon the terms of an arrangement with Belgium. They will probably find that trade reconstruction is only possible by adopting a much broader policy than that suggested by the short-term treaties, and already powerful commercial interests in France are strongly agitating for more liberal dealings with foreign countries, whereby it is alone possible to develop business along normal lines.

The number of engineering contracts being given out for the French Colonies lends interest to the change which seems to be taking place in the attitude of the colonial propagandists towards the participation of foreign firms in the development of overseas possessions. When M. Sarraut, during his visit to the United States at the time of the Washington Conference, invited American firms to help in the work of opening up the Colonies, a strong protest was aroused in France against foreigners being granted colonial contracts. It is now seen that there is so much to be done that French manufacturers can hardly expect to carry out the whole work themselves. If foreign enterprise is excluded, the colonial development will be retarded for a very long time, and it is obviously to the interest of France to seek the aid of foreign engineering firms, if by so doing she can hasten the period when the Colonies will be sending their products in profitable quantities to the Mother Country. It is true that for the construction of ports and the laying down of railways, the resources of French engineering firms have been amply sufficient, but there is a great deal of machinery and plant that can only be supplied by British manufacturers, who make a speciality of colonial needs, and in view of the evolution which seems to be taking place in the French commercial policy, it may be hoped that reciprocal arrangements will be come to whereby British makers will be able to send machinery to the French Colonies under less prohibitive conditions than exist at present. There

is a good demand for colonial machinery, and it continues to grow, and colonial administrators themselves are in favour of facilitating the importation of foreign machines, especially those that are not produced in France. As an example of what is being done in French West Africa, tenders are now being invited in France for the electrification of the Kayes-Thiès line, which is the beginning of the scheme that provides for the creation of a vast cotton and grain producing industry in the Niger Valley.

Literature.

SHORT NOTICES.

The Year Book of Wireless Telegraphy and Telephony. London: The Wireless Press, Limited. Price 6s.—The new edition of this book, which has just reached us, has been remodelled in order to make it conform with present-day requirements; the volume has also been considerably enlarged. The map section, which shows at a glance the position of every known land wireless station in the world, and which is printed in two colours, will undoubtedly be of great interest to many who are professionally or otherwise connected with wireless work. Another section well worthy of mention, which has just been added is that devoted to radio direction finding. In it is to be found a *résumé* of the progress of wireless direction finding, and the laws and procedure governing its use in the various countries of the world. A valuable historical survey has been prepared by J. St. Vincent Pletts, and this survey, together with the national *résumés* for the past year, forms a complete record of the development of wireless telegraphy and telephony throughout the world. The directory of the wireless stations, both commercial and experimental, and the amateur experimental section have been re-compiled. Altogether, the volume is of considerable interest and value to all who are in any way connected with wireless work.

X-Rays. By G. W. C. Kaye. Longmans, Green and Co. 39, Paternoster-row. Price 16s. net.—The use of X-rays, has increased so rapidly that it is now very difficult to deal with the subject adequately in a reasonably sized book. The fourth edition of this volume covers many branches of the subject of interest to students of physics and others. Parts of the book, such, for instance, as Chapter XII., on X-ray equipment and technique, are not without interest to practical electricians who may desire to familiarise themselves with X-ray apparatus. Other sections of the book are, of course, far more technical, but not by any means without value to those connected with X-ray work. The fact that a fourth edition has been published is sufficient to indicate that the volume possesses merit.

Printing Telegraph Systems and Mechanisms. By H. H. Harrison. London: Longmans, Green and Co., 39, Paternoster-row. Price 21s. net.—To the designer of telegraph machinery and others who take an interest in telegraphy this volume should prove of considerable value, for it contains a great amount of information appertaining to the mechanisms used in this class of work. The author has endeavoured to classify all types of telegraph mechanisms and to give examples of each, so that the reader can analyse any system that is claimed to be new and find where the novel feature lies. The book contains eight chapters, 429 pages, 420 illustrations, and throws much light upon the ingenuity that has been displayed in the design of printing telegraph systems and mechanisms.

BOOKS RECEIVED.

Catalogo de la Biblioteca Nacional de Marina, 1922. Buenos Aires: Imp. Ferrari Horos, Balcarce 341.

How to Build Amateur Valve Stations. By Philip R. Coursey. London: The Wireless Press, Limited, 12 and 13, Henrietta-street, W.C. 2. Price 1s. 6d.

Electrons, Electric Waves and Wireless Telephony. By J. A. Fleming. London: The Wireless Press, Limited, 12 and 13, Henrietta-street, W.C. 2. Price 7s. 6d. net.

Metals and Metallic Compounds. By Ulick R. Evans. Vol. II.: Metals of the "A" Groups. London: Edward Arnold and Co., 43, Maddox-street, W. 1. Price 18s. net.

Planing and Geodetic Surveying for Engineers. Vol. I.: Plane Surveying. By David Clark. London: Constable and Co., Limited, 10–12, Orange-street, W.C. 2. Price 26s. net.

Planing and Geodetic Surveying for Engineers. Vol. II.: Higher Surveying. By David Clark. London: Constable and Co., Limited, 10–12, Orange-street, W.C. 2. Price 25s. net.

Alternating Current Electrical Engineering. By W. Tolmé Maccall. London: W. B. Clive, University Tutorial Press, Limited, High-street, New Oxford-street, W.C. Price 15s.

The Radio Experimenter's Handbook. Part II.: Data and Design. By Philip R. Coursey. London: The Wireless Press, Limited, 12 and 13, Henrietta-street, W.C. 2. Price 3s. 6d. net.

Metals and Metallic Compounds. By Ulick R. Evans. Vol. I.: Introduction, Metallography, Electro-chemistry. London: Edward Arnold and Co., 41 and 43, Maddox-street, W. 1. Price 18s. net.

Special Steels, Chiefly Founded on the Researches regarding Alloy Steels. By Sir Robert Hadfield. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 5s. net.

A Handbook of Testing. Vol. II.: The Theory of Prime Movers. By C. A. Middleton Smith and A. G. Warren. London: Constable and Co., Limited, 10–12, Orange-street, W.C. 2. Price 22s. 6d. net.

The Gas Turbine in Theory and Practice.

No. V.*

THE absolute thermal efficiencies which were shown to be attainable on the air cycle chosen for purposes of comparison are very distinctly modified when it becomes a matter of dealing with the actual working substance employed in the internal combustion turbine, and when the practical factors begin to intervene in the problem. Hitherto the thermal efficiencies quoted in the tables have been based on a constant value of the specific heat at constant pressure of 0.24, and with an assumed index of compression and expansion of 1.41. In the case of the working installation it is necessary to take into account the following influences which affect the absolute thermal efficiency for a given compression ratio:—

(1) There is the variation in the value of the specific heat,

(*a*) With the nature of the fuel and the mixture strength used, and

(*b*) The variation of the value with temperature and to some extent with pressure; and

(2) The loss due to radiation in the furnace zone.

Both of these tend to reduce the thermal efficiency, but they are largely offset, if not more than counter-balanced, depending on the conditions, by

(3) The value of the heat in the exhaust gases for regenerative purposes.

Hitherto Holzwarth is the only constructor who has utilised the exhaust gases, and in his case the steam generated was used for the purpose of operating a small and very high-speed turbine which drove his compressor and exhauster. In gas engine work, of course, the exhaust gases have been used for a multiplicity of purposes. In cases in which this heat is sacrificed and allowed to escape without being utilised, although a reduced efficiency must be accepted, it is possible to arrive at the unique result of producing a prime mover in which water plays no part whatever. In fact, with the exception of the windmill, as some forms of the gas turbine need require no water for cooling purposes, it is the only prime mover which can, if necessary, be made entirely independent of water supply.

THE FUEL QUESTION.

The smaller experimental turbines were run with paraffin or petrol. Holzwarth has experimented very widely with various fuels, using generator gas, coke-oven gas, and even, he states, heavy tar oils in his first experimental machine, though it is difficult to believe that the latter fuel can be altogether satisfactory in an explosion chamber working with low compression and low wall temperatures. The question of fuel is of very great importance, for it is mainly on its nature that the choice of cycle, and with it the whole general design of the turbine, will depend. While the constant volume cycle is well suited with gaseous fuels, oil fuel rather demands the continuous burning in the constant pressure cycle instead of the intermittent explosion of the C.V. cycle. With this, we deal later. In the case of the C.P. cycle, whether with gas or oil, the first item to be affected is the compressor; the second is the furnace, and in the design of this an otherwise efficient gas turbine may be made or marred. First of all, it is vital to reduce radiation to the lowest possible amount, for the gas turbine furnace losses occasion a far more serious overall loss than they do in the case of a boiler. With oil fuel atomisation and injection into the furnace will follow more on the lines of boiler practice than on those of oil engine practice. That is, with the C.P. cycle the fuel will be burnt rather than exploded, as is the case with the C.V. cycle. In oil-fired boiler practice, even with very high water gauge pressures—say, 6in. to 7in.—the actual pressure above atmosphere in the furnace is very small, being only about one-quarter of a pound per square inch. The pre-heating and pre-compression of the oil vary, according to the nature of the fuel and the system used, from, say, 150 deg. to 200 deg. Fah. and 150 lb. to 200 lb. pressure, and the quantity of oil burnt per cubic foot of combustion space should not exceed about 6 lb. to 8 lb. for normal working, though as much as 12 lb. to 14 lb. per cubic foot has been burnt efficiently in large water-tube boiler furnaces at maximum power. In these cases the ratio of air supply per pound of fuel is approximately 18 lb. to 20 lb. In a Diesel type engine the ratio of the $\frac{\text{air actually required}}{\text{air required for complete combustion}}$ instead of being about 1.25 to 1.4, as in the case of efficiently operated boilers, rises to about 1.8 to 2.0, but the rate of oil consumption per cubic foot of cylinder volume is not directly comparable with boiler practice. It is true that as regards $\frac{\text{total oil burnt per hour}}{\text{total cylinder volume}}$ it runs about 6 lb. per cubic foot; but considering the explosion period only, it may be from four to five times this amount. In the Holzwarth oil combustion turbine, in which a very much weaker mixture was used and explosions per chamber per minute ran about sixty, the rate per cubic foot was merely fractional. In the C.P. gas turbine a weaker mixture than is used with engines is necessary in order to restrict the temperatures, and from 30 lb. to 33 lb. of air per pound of oil may be required, or an excess air factor of about 2.2, compared with 1.3 in the case of boilers. These air quantities may be approximated by dividing the calorific value of the fuel as fired by lines 11 and 12 in the cycle tables given above. The quantity must be kept down to avoid excessive negative work; it must be kept up to avoid excessive temperature of the gas leaving the furnace. Even with furnace pressures which would be very low indeed from the point of view of pre-compression in motor car cylinders, let alone in oil engines, the circumstances surrounding oil *burning* (not exploding) under pressure are very different from those in a boiler furnace, and both pressure and the great volume of gas to be handled introduce many minor problems, all of which require individual solution. The burning of oil fuel in very dense air is one; the behaviour of the furnace lining if the combustion chamber volume be restricted, and hence if high gas speeds are used, is another, and the difficulty of getting the requisite area through the nozzles without going to large diameters is a third. As soon as large diameters become necessary the expansion difficulties become formidable, while with large furnace volumes, and hence large external areas, the radiation losses are apt to be high.

With producer, coke-oven or blast-furnace gases rather different problems are involved. In the case of the gas engine both cooling and scrubbing are essential in view of the danger of deposition in the cylinders. The former involves a considerable loss in heat and would appear to be quite unnecessary in the case of the C.P. gas turbine, which would therefore gain to the extent of some 8 or 10 per cent., assuming the usual cooling to be about 120 deg. Fah. from a producer exit temperature of about 850 deg. Fah. Some form of "dry scrubbing" will probably be required to remove dust and solid foreign matter in the gas, but much depends on the extent of the completeness of combustion in the furnace. With gas as fuel the turbine would be worked preferably on a sub-atmospheric cycle, the compressor being used as an exhauster to withdraw the gases from the turbine and discharge them to the atmosphere. This removes the difficulty of the compressor being required to handle gases containing deposits or matter in suspension and which would be consumed in the furnace. This aspect of the gas turbine problem is a highly attractive one. The saving in cooling goes a long way to offset the lower efficiency compared with the gas engine, and the turbine is capable of being made in any size.

THE VARIATION IN SPECIFIC HEAT.

The precise determination of the specific heat of gases over a wide range of temperature and especially at high temperatures presents many difficulties. It is, perhaps, rather in the nature of avoiding an unpleasant question than an accurate assessment of the case to suggest that approximations are quite sufficient in view of the other margins which it is necessary to assume. It is perfectly true that highly efficient oil engines are produced without any more accurate knowledge of the specific heat of gases than we possess at present; equally so, that highly efficient steam turbines were in operation long before Professor Callendar produced his now standard determinations of the properties of steam. But the gas turbine is in rather a different position; it is an engine in which at present theory is preceding practice, a conditon which is an entire reversal of experience with the steam turbine. The subject is one demanding extensive treatment to itself; it must suffice here to point out the approximate extent to which the figures for absolute thermal efficiency given in the cycle tables are modified in practice, though the relative values will hardly be affected. The whole question of the determination of specific heat values is likely to involve very considerable discussion in the future. It is abstruse; the determinations by different investigators vary considerably among themselves; the values for some gases are more accurately known than for others; in many cases the method of determination used is open to criticism. We do know, however, that the values are of a very fluctuating nature. To take but one case out of many, there is the value for superheated steam. This varies with pressure and temperature within such wide limits as 0.64 for 400 lb. absolute pressure and 50 deg. Fah. superheat, and 0.50 with 50 lb. pressure and 400 deg. Fah. superheat.* This variation is no less than 28 per cent., though the total temperature of the former is 500 deg. Fah. and of the latter 698 deg. Fah. Over a range of, say, 400 deg. to 2800 deg. Fah. (not absolute T.) the increase in specific heat at constant pressure for oxygen, nitrogen and CO is only small, being about 7 per cent. or so, while for CO_2 it increases from less than 0.20 to more than 0.30. We know from the researches of Holborn and Jakob† that there is a distinct variation in the specific heat of air with pressure, and that it is considered that the variation in the case of other gases would probably be of the same order, though the amount of research work done

* No. IV. appeared May 25th.

* See Dr. W. J. Goudie's excellent work on "Steam Turbines" and his rendering of Professor Callendar's figures, page 169. Compare this with certain foreign determinations.

† Z.d.V.D.I., 1914 and 1917.

on the variation with pressure is very small. One has only to bear in mind the history of the determinations of the properties of steam, and particularly superheated steam, within fairly recent years, in order to find a remarkably parallel state of affairs with that now existing over gas constants.

In the case of the gas turbine the large quantity of excess air certainly tends to leaven the extent of the variation with temperature which would occur if the CO_2 and H_2O contents were proportionately greater. As it is, in lieu of the mean value of 0.24 assumed for calculating the cycle tables, it is not unreasonable with heavy oil as the working fuel to assume for the moment that between 800 deg. and 2400 deg. Fah. there is a straight line variation between, say, 0.25 and 0.27. These figures are open to criticism, but in any case the values are appreciably greater than the 0.24 assumed for the air cycle. In modifying the cycle tables these higher values affect the work done in adiabatic expansion by the working substance. The compression of air is not affected so much, as the final temperature is so much lower than that after the heat addition takes place, and the specific heat of air is in any case less. The reduction in available work of expansion is of the order of 8 per cent., taking a rough mean value, and hence both the ratio of $\frac{\text{positive}}{\text{negative}}$ work and the absolute thermal efficiency are likewise affected. With higher temperatures—luckily for the immediate prospects of the I.C. turbine at those beyond present convenient limits—the reduction is even greater. This increase of specific heat with increase of temperature (as we do know) and with increase of pressure (as we strongly suspect, until more certain data is available) results in a definitely inferior utilisation of heat when the actual working substance—whatever that mixture may be—is employed compared with the air cycle previously assumed. In the case of the explosion turbine our knowledge is much less determinate.

Radiation.

The loss in radiation in the gas turbine may be very serious unless proper measures be taken in the proportions and details of the design to eliminate it as far as possible. There is a remarkable opening for systems of heat retention which have not so far even been attempted.

As with the loss due to specific heat variation, the main radiation loss affects the quantity of heat available for expansion before it even reaches the turbine nozzles to undergo transformation into kinetic energy. Yet again is the ratio of positive to negative work reduced, and the effect of this, as shown in Fig. 4, Part II. *et seq.*, is very telling. The furnace problem is a complex one. It is desirable to restrict the size from all reasons of cost and thermal losses; on the other hand, combustion is never satisfactory under ordinary conditions if ample space is not available, and if the gas speeds used are high, difficulties arise both from erosion of walls and greater transmission to the surface.

Coupled with radiation loss, it may be necessary, as Armengaud and Lemale found, to cool the nozzles. Again there will be a reduction of the heat available for expansion, while the amount added in the furnace remains the same.

Thus, if H be the quantity of heat units available for expansion according to the quantity admitted to the system per pound of working substance, $C\,p$ and $C\,p'$ be the values of the specific used in compiling the tables and for the actual mixture used, R the percentage loss in furnace radiation, and N the percentage loss expended in cooling the nozzles, the number of heat units actually available in practical work for expansion become equal to $H \times \frac{C\,p}{C\,p'} \times (1 - R) \times (1 - N)$, and the value of the last three terms may easily reach 10 to 15 per cent. It must not be overlooked that this reduction affects both the value of K in the formula for overall efficiency—see page 517—and the absolute thermal efficiency, so that the brake thermal efficiency is reduced to a much greater extent than the direct reduction of H would indicate at first sight. It should also be remarked that reducing the radiation loss does not by any means cause a corresponding gain, because the value of $\frac{C\,p}{C\,p'}$ will fall.

The Utilisation of the Exhaust Gases.

The utilisation of the exhaust gases from internal combustion engines is impossible in the same manner as is accomplished in steam practice, where an exhaust turbine may very advantageously be used to extract the large amount of energy still remaining in the steam below the release pressure in the engine cylinder. Only in the case of aeroplane engines, in which special conditions intervene, is such an application at all practicable, and then only because the exhaust turbine is not a self-contained unit, but merely an adjunct to another engine. Exactly how to deal with the exhaust gases from an I.C. turbine will probably continue to be a vexed question for some time to come. With the permissible present-day nozzle and furnace temperatures the proportion of heat rejected is considerable, and it depends very largely indeed on the nature of the complete installation and on the type of turbine as to how, and sometimes even whether, this heat should be used. One very practical question intervenes here: that is the question of the sulphur content in the fuel, which in the case of heavy oil may amount to as much as 30 lb. per 1000. The high radiation loss round a C.P. furnace may be prevented by water jacketing, as in Lemale's machine, the steam thus formed being injected into the furnace in order to reduce the gas temperature. If this system is chosen the exhaust gases may well be employed to heat a feed-heater for this "boiler," because in the C.P. turbine it is advantageous to use steam injection, (*a*) to reduce the temperature and (*b*) because it increases the ratio of positive to negative work. Owing, however, to the sulphur content in the oil there is considerable danger of the formation of sulphuric acid from the sulphur dioxide resulting from the combustion, and its presence prevents the subsequent use of the jacket water, which is consequently lost. The use of the gases simply to raise steam, which can, of course, be used in various ways, entails a large heating surface and all the elements of a steam plant—feed, air, circulating pump and condenser—which it is obviously desirable to reduce as far as possible. The size, weight and cost of these soon grow to a point at which they form a very considerable proportion of the whole installation. With a C.V. type of turbine the gases will raise more than ample steam for compression and exhaustion, and in a big plant, such as the proposed German coal carbonising and by-product recovery plant, this steam can be used for several other operations as well. Under these conditions plant efficiency must be considered as well as merely turbine efficiency. If the steam be used for injection into the furnace the influence on efficiency will be much less beneficial in the C.V. type of turbine than in the C.P. type, where the ratio of $\frac{\text{positive}}{\text{negative}}$ is low. If it is expanded in a separate turbine the dimensions of the plant are increased and any estimate of the advantages of the then so-called "gas" turbine, which really becomes a mixed steam and gas plant under those conditions, must be considered in relation to a *complete* steam plant, *i.e.*, between fuel storage and circulating water outlet and not merely in comparison with those of the motor only. It is the presence of the steam generator and condensing plant with all their accessories that admit scope for the gas turbine plant; the space occupied by the latter is vastly less. The value of regeneration must obviously depend largely on circumstances. With an exhaust temperature of 800 deg. to 900 deg. Fah. and the furnace temperatures and blade velocities permissible in practice to-day it is probably advantageous in many cases from the point of thermal efficiency. With a lower exhaust temperature, however, it adds considerably to the cost of the plant and introduces a considerable quantity of pure steam machinery. Without regeneration no water need be used at all, and in very many cases this constitutes a very considerable advantage in itself.

The Explosion Turbine.

In our next article it is proposed to deal fully with the Holzwarth constant volume turbine. In point of date, however, the first explosion turbine of which any test data is available is the little Karavodine turbine built in Paris in 1903. This machine was of the "open chamber" explosion type, as contrasted with Holzwarth's "closed chamber" machine, and the heat addition took place with both pressure and volume changing; that is, on a cycle intermediate between the C.P. and the C.V. types. The only merit of machines of this class is their extremely simple construction. They are very inefficient and consequently very unlikely to compete with the small oil or petrol engines now on the market for agricultural or similar purposes.

There was not much detailed information published regarding the Karavodine turbine. An old Laval wheel and cylinder were used, the former about 6in. in diameter and running at 10,000 revolutions per minute. The arrangement of the combustion chamber E is indicated in Fig. 7. F is a water jacket surrounding the lower portion of the chamber only, the idea being to allow the upper end to maintain a higher temperature. The volume of each of the four chambers fitted was about 14 cubic inches. To start the machine a strong fuel charge was forced through the fuel inlet at A, the air supply at B being shut off. This lifted the automatic valve C, the lift of which for running purposes is adjusted by the spring D, and was fired by the igniter at G, the products of combustion passing out through the 16 mm. nozzle pipes on to the turbine wheel. The explosion creates a slight vacuum, or rather pressure depression, in E, and as the air inlet is opened the air supply becomes automatic as each explosion draws in the charge for the subsequent one of its own accord. The explosions begin to follow one another rapidly, and the igniter can soon be dispensed with, as the chamber top acts as a hot bulb. Actually the machine was run at as many as forty explosions per second. Each nozzle pipe is a coil about 10ft. long, and the fluid friction therein makes any back suction of the burnt gases very small. The suction pressure was about 1½ lb. below atmosphere and the explosion pressure about 5 lb. above atmosphere. A larger combustion chamber was also tried, but with indifferent results. M. Barbezat states that the machine developed about 1.6 brake horse-power, and that the petrol consumption was about 6 lb. per horse-power per hour. This gives an efficiency of only about 2.4 per cent. Obviously, the losses due to cooling and radiation and the valve and air supply adjustment must affect the working to a wide extent, but the principle of setting columns of air in motion by the explosion of charges is thermodynamically very inefficient. Considerable improvements in the design of combustion chamber, nozzle and wheel could easily be made to-day, and by dispensing with the water jacket and using a two-row wheel a more economical machine could easily be provided. Such a design might well compete with the small non-condensing steam engine and boiler, but it is doubtful if it could do so with any small oil engine even as regards simplicity.

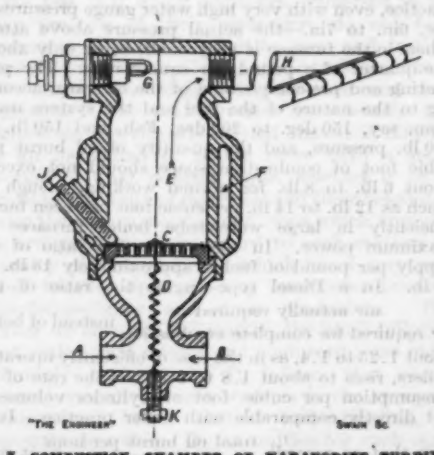


FIG. 7—COMBUSTION CHAMBER OF KARAVODINE TURBINE

New Gasworks at Carlisle.

No II.*

The Boiler Installation.

The waste heat boilers are 4ft. 10in. high by 4ft. 2in. dia. at the top and 3ft. 8½in. dia. at the bottom. The fire-box is 3ft. diameter, and contains ninety 1¾in. solid drawn steel tubes. The heating surface of the fire-box is 28 square feet, and that of the tubes 92 square feet, making a total of 120 square feet. Each boiler consists of an inner cylindrical fire-box through which the waste gases pass and an outer shell. The 1¾in. steel tubes are expanded into the fire-box, and are disposed in a special manner, so as to split up the gases as they pass through the fire-box and thus give a highly efficient heating surface. By breaking the top and bottom joints the shell may be moved clear of the fire-box and tubes for inspection, cleaning, or examination. The superheater consists of a conical coil of tubing fixed at the top of the boiler by means of brackets from the crown plate. The superheater is enclosed in a steel shell lined with firebrick. These boilers occupy very little floor space, and are supported on a cast iron ring lined with fire-brick. Each boiler is arranged on a by-pass from the chimney of the particular setting to which it is attached, and is operated entirely by natural draught, the waste gases being passed through the boiler or through the chimney, or partly through both by the manipulation of dampers. So far each boiler has been capable of supplying steam at a superheat of 250 deg. Cent. to eight retorts. The steaming arrangements are very complete, all the boilers and retorts being interconnected with suitably disposed feeding points on well-lagged pipe lines, so that steam from any or all of the boilers can be supplied to any or all of the retorts.

Coke Handling Plant.

Coke from the bottom retort mouth pieces is discharged by means of a light travelling chute to either of the two lines of lip-bucket conveyors—see the drawings on page 542, *ante*. These are arranged in the tunnel under the retort bench, the roof of the tunnel being designed to feed the coke to the buckets without breakage and without overloading. From these conveyors the coke is delivered to a receiving hopper at the extension end of the retort-house. From the hopper it passes through a coke breaker, which can be put out of operation at will, to a West automatic skip filler with 1-ton skips handled by an electrically-operated gib crane, capable of dealing with loads of 2 tons at 35ft. radius. This crane was built by Cowans, Sheldon and Co., Carlisle. The overhead return strands of the lip-bucket conveyors are carried by steel lattice girders spanning between the end house and the retort-house at such a height that a future extension of the retort bench can be erected beneath without interfering with the operation of the existing plant. Coke for the producers and retorts is handled by the same lip-bucket conveyors, and delivered to hoppers suitably disposed in the retort-house to enable supplies to be taken in skips hanging

* No. I. appeared May 25th.

NEW GASWORKS AT CARLISLE

MR. J. E. BLUNDELL, CARLISLE, ENGINEER

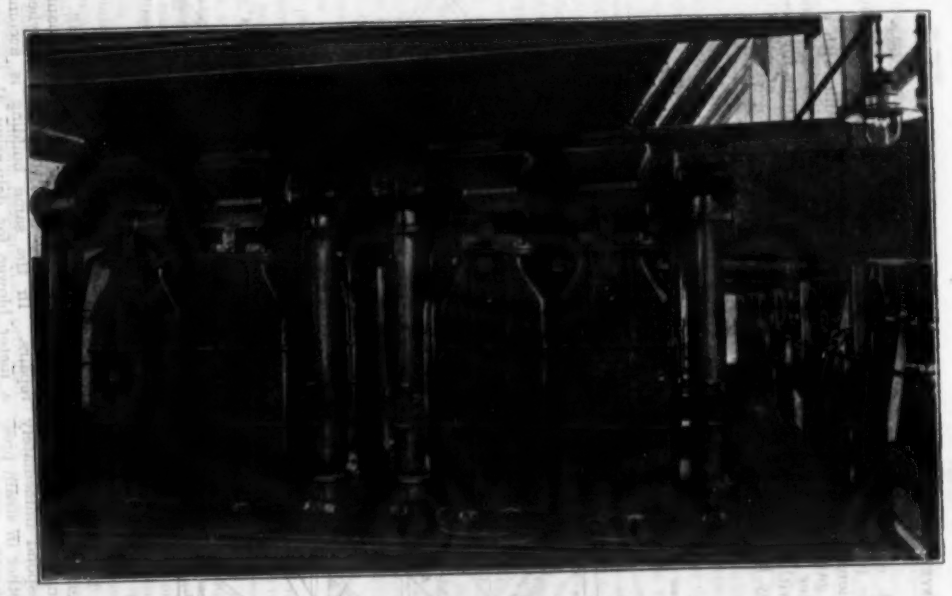


FIG. 8—RETORT CHARGING STAGE

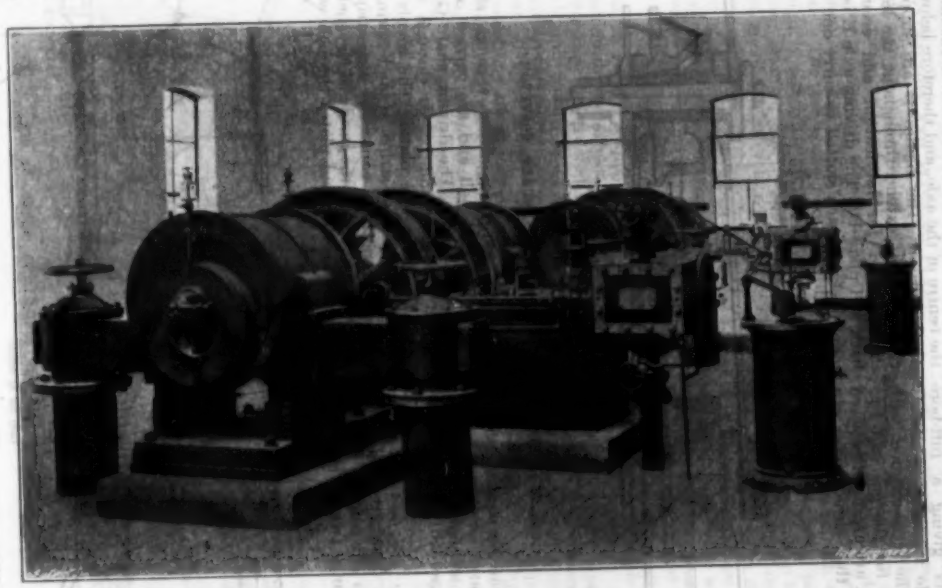


FIG. 9—THE GAS EXHAUSTERS

FIG. 10—THE GAS WASHING PLANT

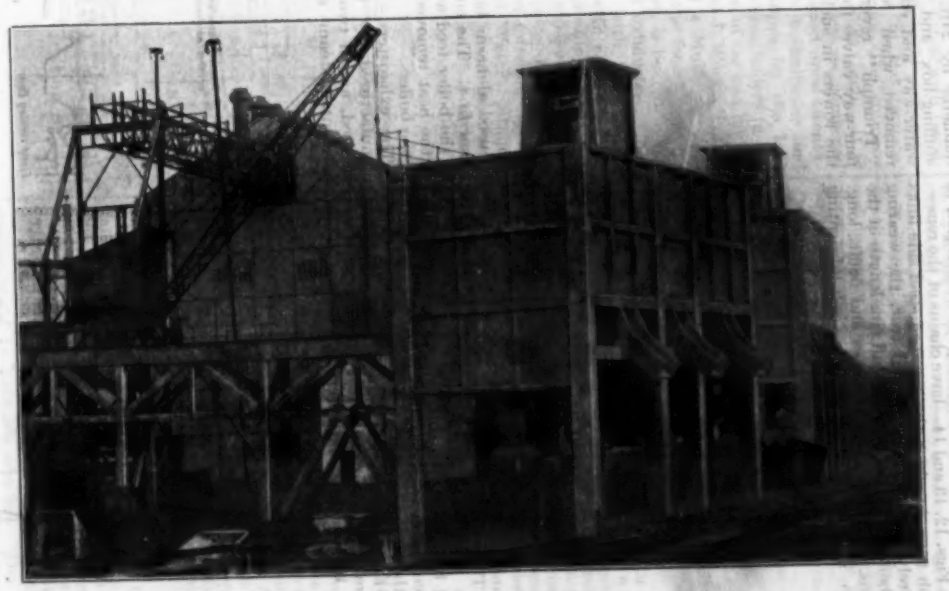


FIG. 11—THE COKE HOPPERS

from carriages supported in ball bearings on runways to any of the retorts when starting up or to the producers. The lip-bucket conveyors—illustrated in detail in Figs. 12, 13 and 14—have chains of the renewable-bush type, in which the stamped steel side links are entirely relieved of wear and tear, the wearing surface being extended over the full 6in. length of the joint pins. The chains are endless and 586ft. long. They are supported on oil-retaining self-lubricating rollers running on steel-angled paths braced into rigid frames. The buckets are freely suspended on trunnions projecting from alternate joints and supported by rollers. In completing the circuit, the buckets remain in the horizontal position until they arrive at the end of the top track, where a fixed dumping cam is provided—as shown in Fig. 14. The buckets are turned over at the last wheel curve of the top track by means of the fixed cam shown. They then turn over a pulley and travel down the guides in a vertical position. As the buckets arrive at the next sprocket wheel they automatically turn over and are then again in the horizontal position. At various positions dumping cams—shown in Fig. 14—are arranged, which can be put into or out of action by hand as desired.

FIG. 12—SECTION OF LIP-BUCKET CONVEYOR

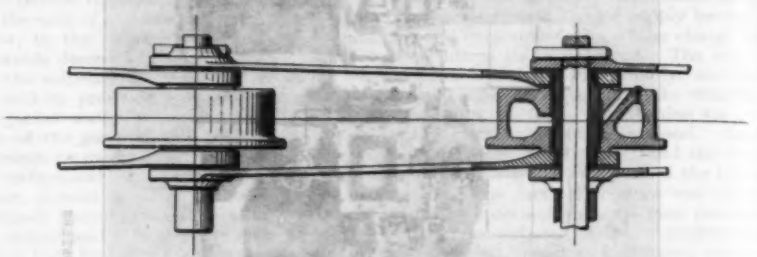


FIG. 13—SECTION OF CHAIN FOR LIP-BUCKET CONVEYOR

The automatic skip filler mentioned above is the outcome of a recent invention. Referring to the illustration—Fig. 15—A is the bunker or hopper fitted at its base with a hinged door B, through which, when opened, the coke descends into a measuring chamber C of sufficient capacity to hold the contents of a skip D. The measuring chamber is also fitted with a hinged door E, and a spout to direct the coke into the skip. The doors of the chute and measuring chamber are inter-connected by linked arms or levers L in such a way that when one is open the other is closed. By means of the lever J the mechanism which operates the two doors is connected to a weighted lever K pivoted, as shown and operated by the skip. When the skip is lowered into the filler by means of the electric jib crane it depresses the adjacent lever K and raises the balance weight, thus closing the door B of the hopper A and opening the door E of the receptacle C. This permits the coke to gravitate down the chute F into the skip. When the latter is loaded and raised or moved away the balance weight of the rocking lever descends and closes the door E. When the skip is in the lowest position the main hopper is closed, the measuring chute is open and coke has flowed into the skip. When the skip is in the intermediate position, the coke has just ceased to flow from the measuring chute and is just beginning to flow from the main hopper. When the skip has ascended clear of the measuring chute, the main hopper is open and the measuring chute closed and quite clear of the skip. When the skip is descending and is in the intermediate position, the coke has just ceased to flow from the main hopper and is just beginning to flow from the measuring chute. A view of the coke hoppers is given in Fig. 11, page 585.

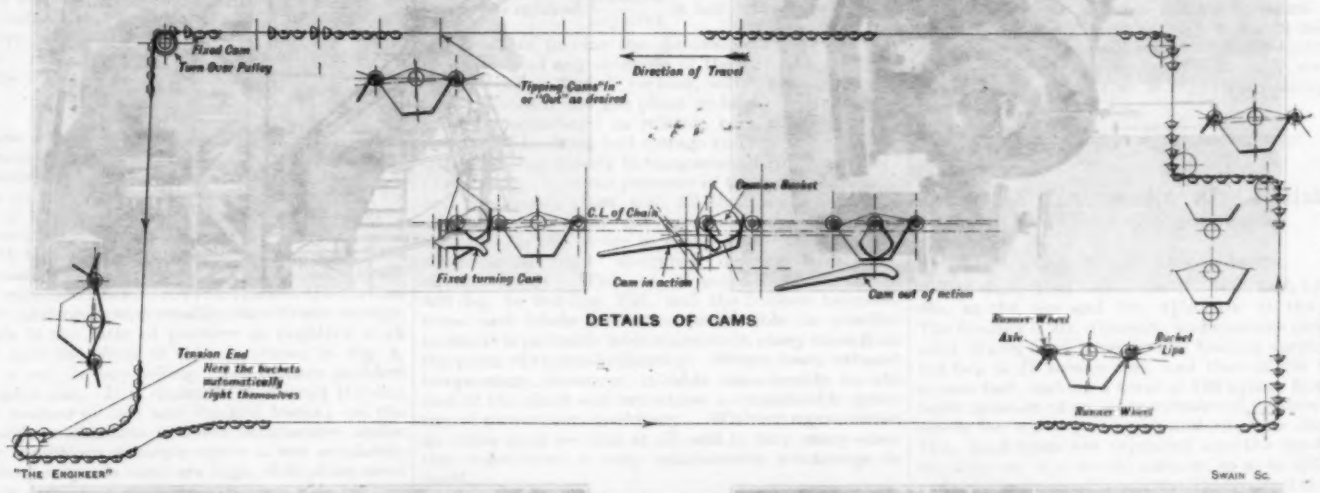


FIG. 14—LIP-BUCKET CONVEYOR SYSTEM

CONDENSERS AND EXHAUSTERS.

The condensing plant consists of a two-tower reversible water-cooled condenser manufactured by Clapham Bros., Limited, having a capacity of 3 million cubic feet of gas per diem. The tubes are of wrought iron, to resist corrosion, 1¾in. outside diameter by 21ft. long and fitted with "Eclipse" stuffing-box and gland joints giving a full-bore water-way and enabling single tubes to be readily removed when required. The connections, with "Triumph" reversing valves for the gas and two four-way valves for the water, are arranged between the towers in such a manner that either tower can be used alone or both towers can be used in series, either first. The condensing water, after use, is led to the boiler feed-water heater, so that 70 per cent. of the heat removed from the gas will be recovered in the boilers.

The exhausters—Fig. 9, page 585, and Fig. 16—manufactured by the Bryan Donkin Company, Limited, are in two sets. Each set consists of one horizontal steam engine driving two exhausters of the four-blade type, each exhauster being of a capacity of 1½ million cubic feet of gas per day when running at 78 revolutions per minute and working against 30in. water gauge. The engines have cylinders 10½in. diameter and 14in. stroke. The stuffing-boxes are fitted with metallic packings so that superheated steam may be used. Each set is mounted on a single cast iron bed-plate, ensuring correct alignment between the engine and the two exhausters. The speed of the engines is controlled by hydraulic regulators which respond immediately to any change of conditions, whether in steam pressure or in the quantity of gas passing through. There is also a 24in. self-acting gas by-pass valve between the inlet and outlet mains. The construction of the exhausters is shown in Fig. 16. The drum or shell A is bored to such a shape that the vertical diameter is equal to the chord struck horizontally through the centre of the axle, and therefore below the centre of the drum. The blades B are supported by a central pin C, extend throughout the length of the drum, bored for lubrication and secured in the back end plate D. The driving axle E is fitted with four rollers F, each slotted to carry one blade. The ends of these rollers project through the axle at each end of the shell and are carried in the race of each end plate. The driving shaft G is cast in one with the axle and passes through a stuffing-box in the front end plate. The revolving blades are fitted with nose-strips H and springs of just sufficient strength to cause the nose-strips to form a gas-tight joint with the inside of the shell. Glands are provided in the end plates through which these strips and springs can be withdrawn without removing the end plates.

The exhauster house is built with a stage floor beneath which the inlet and outlet connections are accommodated with good facilities for access to joints and valves. The building is of ample dimensions to allow for subsequent extension of the plant. It is constructed with steel girders built into the roof with a runway and lifting tackle for manipulating the heaviest parts of the machines when under repairs. In the same building is accommodated a meter blower for delivering 2½ per cent. of 2½ million cubic feet of air against 30in. water gauge pressure to the purifiers for revivification *in situ*. It consists of a small blower driven by a horizontal

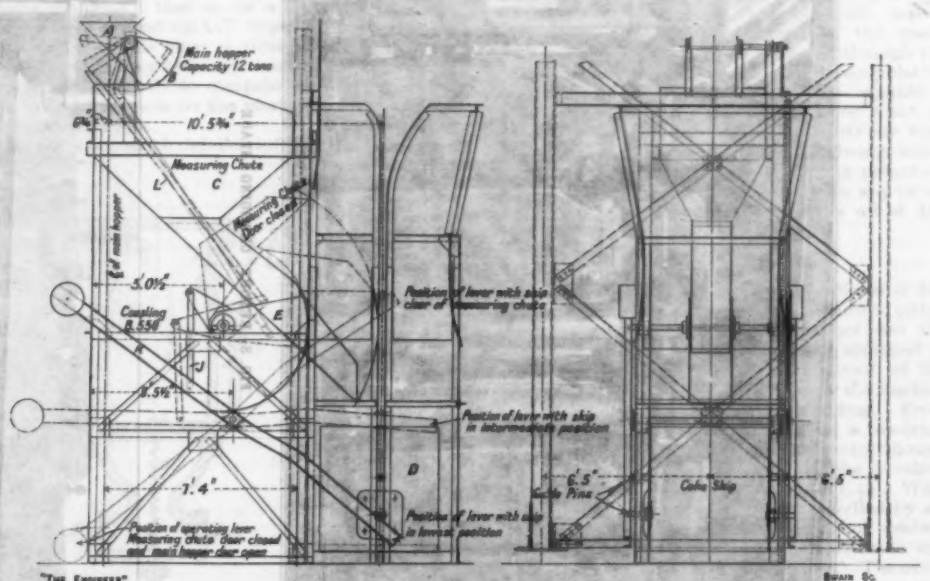

Main hopper Capacity 12 tons
10'. 5¾"
Measuring Chute
Measuring Chute Door closed
Position of lever with skip clear of measuring chute
Coupling
Position of lever with skip in intermediate position
7'. 4"
Position of lever with skip in lowest position
Position of operating lever Measuring chute door closed and main hopper door open
6'. 5"
Coke Skip
"THE ENGINEER"
SWAIN Sc.

FIG. 15—AUTOMATIC SKIP FILLER

steam engine and fitted with a counter from which the total quantity of air passing to the purifiers can be ascertained in the same way as from a gas meter.

TAR EXTRACTION AND WASHING PLANT.

The tar-extracting and washing plant comprises one Livesey washer and two washer-scrubbers. It is designed for a capacity of 3 million cubic feet of gas per diem, and was built by W. C. Holmes and Co., Limited. The tar extractor is of the usual Livesey design, fitted with ample means of access for inspection, cleaning and renewal of tubes, and is placed at such a level relative to the washer-scrubbers as to permit of the overflow liquid from the latter being run through the tar extractor before finally entering the wells, without the necessity of pumping.

AMMONIA RECOVERY.

The ammonia recovery apparatus consists of two Holmes brush scrubber-washers—see Fig. 10, page 585 These machines are constructed on the "two unit" system, each unit consisting of five double washing chambers with revolving brushes coupled to a central driving gear and horizontal steam engine. The by-pass connections are arranged overhead throughout, thus dispensing with drains and syphons, and giving complete access to the valves for inspection and cleaning. The two machines may be worked

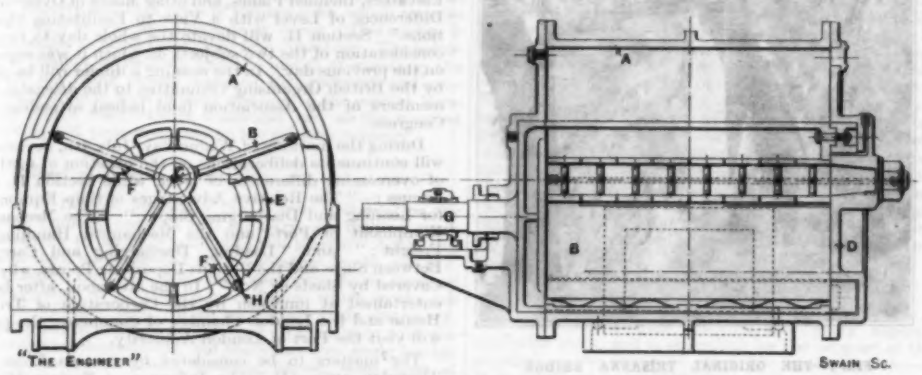


FIG. 16—CROSS AND LONGITUDINAL SECTIONS OF GAS EXHAUSTER

either in series or in parallel. The washing liquor is run by gravity through the whole system, to ensure the maximum strength being maintained, while the final chambers are supplied with water only. An important mechanical feature of the machines is that there are no rubbing metallic surfaces in the interior; the shaft bearings are carried on brackets bolted externally to the end cover plates.

PURIFICATION PLANT.

The purifiers are designed for a capacity of 3 million cubic feet of gas per day. They were constructed by Clapham Bros., Limited, in one unit on a concrete bed, and comprise four boxes each, 40ft. square by 6ft. deep, with a fifth, or catch, box of the same dimensions. The boxes are fitted with three tiers of ordinary timber grids. Each box is provided with six ¾in. cambered steel covers, secured with a dry lute of the Eclipse type, and twenty-six swing bolts to each. The lifting apparatus consists of a light traveller running on rails fixed to the purifier deck. Gearing is reduced to a minimum. The traveller runs easily on ball bearings when pushed by hand, and the lifts are elevated by screws mounted in ball-thrust bearings. The Triumph reversing valve, which is fitted with axial relieving gear for easy manipulation, is arranged to allow of any one, two three or four of the purifiers being worked in series, any box first, and in any rotation. The catch box is independently controlled. The purifier valves and connections are 24in. diameter, and each box is fitted with two 6in. air valves and 2in. drain pipes and cocks for the condensates. An oxide shed, 175ft. by 30ft., is erected on ground adjoining the purifiers.

The Station Meter and Governors are accomodated in separate buildings to the north of the site in close proximity to Rome-street and the mains leading to the districts.

One new station meter, of a capacity of 70,000 cubic feet per hour, has been installed, of Braddock's manufacture. Four station governors, one 24in., one 18in. and two 12in., have been erected, all complete with by-passer. They are manufactured by Parkinson and Co., and each consists of a bell working in water and lifting a double-cone valve under the influence of the outlet pressure. The bell and valve are counterbalanced by an air vessel, and pressure is added by weights. The double-cone valve is in equilibrium against changes of inlet pressure. The bell is isolated by an annular water-seal and receives its pressure influence from the outlet through a small control pipe and adjusting cock. This type of governor will give a perfectly straight line on the pressure chart, whatever variations may occur in the inlet pressure or outlet consumption, provided there is a reasonable margin of inlet over outlet pressure.

Steam Generating Plant.—The works are furnished with boiler and pumping plant. There is accommodation for four boilers, of which two, of the Lancashire type, 8ft. diameter by 30ft. long, were installed by Galloways, Limited. They are fitted with Goodrich and Hamlyn steam-jet forced-draught apparatus arranged for burning coke-breeze in the furnace, and superheaters by the same firm. The chimney is 5ft. 9in. internal diameter by 150ft. high. It is built in brick supported on foundations composed of a concrete cap 3ft. 6in. thick carried upon twenty-nine ferro-concrete piles. In the boiler-house and the adjoining pump-house are pumps for the feed of the main boilers and the waste-heat boilers in the retort-house, and for the circulation of tar and liquor. The boiler feed pumps are by G. and J. Weir, Limited, Glasgow, who have also installed a Multiflow feed-water heater by means of which the feed, including water already heated in condensers, is heated by exhaust steam from all pumps and exhausters. This apparatus is capable of dealing with 2000 gallons of water per hour. It is fitted with a by-pass and facilities for examination and cleaning, and it is placed in a convenient position at the back of the boiler-house adjacent to the pump-house. The boiler plant is equipped with water-softening apparatus manufactured by the United Water Softeners, Limited, capable of reducing the hardness factor of the water supply from 11½ to 4, with a capacity of 2000 gallons per hour.

The works are completely equipped with mains and connections, comprising 24in. gas mains within the works, gas mains leading to the districts, with a culvert under the railway, tar and liquor mains, water mains, including the main supply pipe from the river Caldew, steam and exhaust pipes. Workshops, including stores, carpenters' shop, fitting shop, and smithy have been built, and space is reserved for the future erection of the whole of the accommodation required by the distribution department. At the main entrance in Rome-street offices and laboratories have been erected. The sulphate of ammonia plant, already existing on the site of the old type, is to be rebuilt.

All the machinery in connection with the handling of coal and coke is operated by electric motors of the totally enclosed ventilated type, using direct current, energy being supplied from the corporation mains at 460 volts pressure. It will have been noted, however, that a number of appliances, such as washers and exhausters, are operated by steam engines, to which the steam has to be conveyed quite an appreciable distance from the Lancashire boilers. It would seem to be more convenient, and probably more economical, to make use of gas engines or electric motors in such cases. As at present equipped, the works are capable of producing about 2½ million cubic feet of gas per day, the maximum production for one day up to now being 1,700,000 cubic feet. At the time of our visit the gas being made averaged a little over 450 B.Th.U.'s per cubic foot. Perhaps the most striking feature of the works was the extremely small working staff required. There are altogether forty-six men; twenty-four on the manufacturing side, eight on maintenance, and fourteen unskilled men.

THE INTERNATIONAL AIR CONGRESS.

THE arrangements for the International Air Congress, which is to take place in London at the Institution of Civil Engineers, Great George-street, London, S.W. 1, from June 25th to 30th, are now approaching completion. Anticipations regarding the value of the papers submitted, we learn, have been more than realised, and the interest of the meetings is fully assured. The papers, which will cover every field of aeronautical development, are thoroughly international in character, as contributions have been received from representatives of—amongst other countries—America, Belgium, Denmark, France, Holland, Italy, Spain and Sweden, in addition to Great Britain. The following is the programme as at present arranged:—

Monday, June 25th.—Morning: Opening ceremony at the Institution of Civil Engineers, Great George-street, Westminster. Inaugural address by the Duke of Sutherland. Afternoon: Simultaneous sessions of Groups A, B, C and D for reading and discussion of papers at the Institution of Civil Engineers, Great George-street, Westminster. Evening: Official reception of members by the president, his Royal Highness the Duke of York, K.G., K.T., at the Hotel Victoria, S.W. 1.

Tuesday, June 26th.—Visits by members to various places of aeronautical interest.

Wednesday, June 27th.—Morning and afternoon: Simultaneous sessions of Groups A, B, C and D for reading and discussion of papers, at the Institution of Civil Engineers. Evening: Reception of members by the Lord Mayor of London at the Mansion House.

Thursday, June 28th.—Visits by members to various places of aeronautical interest.

Friday, June 29th.—Morning and afternoon: Simultaneous sessions of Groups A, B, C and D for reading and discussion of papers, at the Institution of Civil Engineers.

Saturday, June 30th.—Morning: Concluding meeting of members in general assembly, under the chairmanship of the Secretary of State for Air, at the Institution of Civil Engineers, Great George-street, Westminster. Evening: Official banquet at the Hotel Victoria, S.W. 1.

Terms of Membership.—The qualification for membership is nationality of a country which is either a signatory of the International Air Convention or represented on the Fédération Aeronautique International. The subscription is one pound sterling or its equivalent in foreign currencies at date of application. Individuals belonging to the families of members may become associate members at a reduced subscription of ten shillings. Applications for membership will be received up to Saturday, June 9th, by the general secretary, Lieut.-Col. W. Lockwood Marsh, 7, Albemarle-street, S.W. 1.

Australian Engineering Notes.

THE management of the Broken Hill Proprietary's steel works at Newcastle (N.S.W.), which were re-opened recently after a long period of idleness, is said to be satisfied with the progress made towards a full resumption of operations. At the end of the first week in April there were approximately 3200 men employed, and it was hoped shortly to add to the number. The company is, it is reported, in receipt of sufficient orders to justify the working of the plant at full blast as soon as this can be accomplished.

* * * * * *

WORK is being pushed on in connection with the Dawson Valley irrigation works in Queensland. It is calculated that in fourteen months' time the water will flow along the channels, and the first farms will be thrown open for settlement. The original proposal was for the storage of 100,000 acre-feet of water, but recent investigations showed the desirability of designing the works so that the ultimate storage would be 2,000,000 acre-feet. The works will eventually serve 200,000 irrigated acres.

* * * * * *

A FIRM of ironmasters, of Lithgow, N.S.W., has purchased a factory site on the Brisbane River, Brisbane, on which works will be erected to carry out an order for £180,000 worth of 36in. and 42in. water pipes for the Brisbane Metropolitan Water and Sewerage Board. The tender provided that the material should be manufactured in Queensland.

* * * * * *

THE contract from the Victorian State Rivers and Water Supply Commission for the supply of an electric generating set for Red Cliffs has been awarded to the Thompson and Co. Pty., Limited, of Castlemaine, Victoria. The price is to be £7896. The same firm has secured the contract for the manufacture and supply of two water-tube boilers for the Millews pumping plant, at a cost of £3958.

* * * * * *

THE Queensland Treasury has approved of loans of £7000 and £15,000 to the Bowen Harbour Board, with which to erect a new pier and provide for the dredging of the harbour. The Board is also considering a further proposal to borrow £3500 to install sugar conveyors on the local jetty, and thus facilitate the rapid handling of sugar cargoes.

* * * * * *

THE largest and most valuable building yet erected in the Commonwealth is about to be started for the State Savings Bank and the Rural Bank. It will be constructed of reinforced concrete and will rise to a height of 204ft. About 100,000 tons of concrete, 3000 tons of steel and 1,000,000 ceramic blocks will be required. The building, which is to the design of Messrs. H. E. Ross and Rowe, Sydney, will take three years to complete, and will cost approximately £700,000.

* * * * * *

DURING 1922 no fewer than 8028 new motor cars were registered in the State of Victoria, not including 673 commercial vehicles. Fords headed the list with 2249, followed by the Dodge with 927. The Tasmanian Parliament has passed a Bill to amend the Motor Vehicles Act. Under the new measure the tax rises from £2 for smaller vehicles to £15 for the larger types. For steam or electric vehicles the rate is from £4 for 1½ tons and under to £50 in excess of 5 tons. Motor cycles will pay £1 per annum. The money thus raised will be used for repairing main roads in the island State.

* * * * * *

THE Wangaratta (Vic.) Water Works Trust has decided to engage Messrs. Noble, Anderson and W. J. Muntz as consulting hydraulic engineers to prepare a plan and specification of a gravitation scheme for the water supply of the town. The water will be impounded 37 miles away and conveyed to Wangaratta in pipes. The scheme will take two years to complete, and is estimated to cost between £50,000 and £60,000.

* * * * * *

THE first turbo-alternator to be manufactured in Australia was recently completed by the English Electric Company of Australia at its Clyde works. This is one of two units each of 2500 kilowatts to be erected at the Ultimo power-house, Sydney, for additional power to the tramway system.

Strengthening the Trisanna Bridge.

ENGINEERING work involving a somewhat unusual and difficult task was recently completed near Landeck on the line over the Arlberg Pass between Innsbruck and the Swiss Frontier.

The Trisanna Bridge—shown in our illustration, Fig. 1—has a single span of some 400ft., which crosses the Patznauer Valley at a height of 287ft. It was erected in 1884, and is made of Styrian welded iron. With the increasing traffic of the last few years the bridge reached the limit of its load capacity, and it became necessary to strengthen it very considerably, especially in view of the heavier electric locomotives which are to be used on the completion of the electrification of the line, which is now in progress. This work had, of necessity, to be carried out in such a way that the normal traffic was not interfered with. Owing to the great height of the viaduct, the erection of fixed scaffolding from the bed of the river would have been much too costly. Consequently, it was decided to employ hanging scaffolding.

The existing bowstring girders were strengthened by means of the addition of two inverted girders of the same type, which are shown in Fig. 3. These new girders were connected with the old girders at both ends of the bridge and also by vertical rods, with the panel points of the tension boom. The efficiency of this method of construction lies in the fact that the tensile stress produced by the weight of the new girders produces a compressive stress in the bottom boom of the old girders and thus materially relieves them. The forces on the vertical rods of the new girders are transferred vertically upwards through the panel points to the struts of the original girders, and in this way not only is relief given to the lower boom but also to the top boom and web bracing. Had the new girders simply been suspended from the bridge, they would only have been effective when a train was actually passing over, and at other times would only have increased the dead load on the existing girders. To overcome this, all the vertical rods were made in two parts and secured together in such a manner that each rod could within certain limits be shortened or lengthened. During the period of erection—see Fig. 2—when these rods had also to carry the hanging scaffolding, the two parts of each rod were bolted together provisionally. After the new girders were erected these provisional fastenings were removed and the girders lowered by windlasses to a position in which the deflection was equal to the deflection which would have been caused by their own weight. During this stage of the work, the entire sub-structure was suspended from the old girders merely by the fastening devices at the ends of the bridge, while all the other panel points of the bottom booms of the old girders were left entirely free so that they had no longer to carry any load. Even at this stage there was a reduction of the tension in the bottom boom as a result of the pressure produced by the weight of the lower girders. The two parts of each vertical rod were later again bolted together, so that the whole strengthening of the girders became fully effective when the first train passed over the bridge after the short suspension of traffic during which the foregoing operations were carried out.

The bolting connections of the vertical rods were only employed in order to reduce the suspension of traffic to a minimum of a few hours, during which time the lowering of the new girders took place. The bolts were subsequently replaced by rivets.

The success of the strengthening work was very satisfactory. Exact measurements showed that the strain in all the parts of the old main girders under a moving load amounted after the new construction to only about half that recorded in the same parts before the work was carried out. This observation is in complete accord with the results of the theoretical calculations which were made beforehand.

In addition to the main girders, both the longitudinal and cross girders of the bridge were also strengthened. In the case of the longitudinal girders a form of truss frame was adopted, which was brought under the girders and secured to them without necessitating any removal of the flooring of the bridge.

The work was carried out from start to finish without the least mishap, but we may mention an interesting occurrence which was referred to in our Journal note of November 3rd of last year, when we placed on record a slight traffic derangement on the Arlberg Railway. On October 28th, when the work of construction was on the point of completion, the engineers found that the joints between the central points of contact were open several centimetres, although there was no load on the bridge. It was concluded that the bridge had sunk and traffic was accordingly stopped. A thorough investigation showed, however, that the openings at the panel points were caused by differences of temperature in the girders. Whilst both the upper and lower parts of the bridge contained about the same weight of structural material, the surface of the upper part was larger by one and a-half times than that of the lower part. It was, therefore, much more quickly affected by changes of temperature than the lower part which, at the time, was completely surrounded by wood scaffolding and thus protected from cold winds. During the night of October 27th to 28th, 1922, snow had fallen in the mountains and a cold wind was blowing through the valley. It reacted much more

FIG. 1—THE ORIGINAL TRISANNA BRIDGE

on the upper part of the bridge than on the lower, and thus caused the openings at the points of contact. As a matter of fact, these gaps closed in the course of the morning, because the lower part of the bridge had subsequently taken on the same temperature as the upper part. This phenomenon was again observed on the following night, but as soon as it was clear that the openings at the joints were not due in any way to a sinking of the structure but only to natural temperature effects, traffic was resumed.

The total cost of the whole work, which involved the use of some 230 tons of mild steel, amounted to 3.8 million of kronen.

The plans for the strengthening of the bridge were prepared by the chief advisory engineer of the Federal Ministry of Traffic, Mr. Friedrich Roth, who also supervised the carrying out of the work. The contractors were R. Ph. Waagner, Limited, and J. Biro and A. Kurz and Co., of Vienna.

FIG. 2—THE EARLY STAGES OF THE WORK OF STRENGTHENING

FIG. 3—THE WORK COMPLETED, BUT SCAFFOLDING NOT REMOVED

A PAPER, recently read before the Wireless Section of the Institution of Electrical Engineers by Professor C. L. Fortescue, deals with an investigation of the proportions and the arrangement of the winding of high-frequency inductances in order to obtain the minimum ratio of R/L. Both stranded and solid wire coils are dealt with, and the unavoidable limitations arising from the space-factor are considered. Results and tables are given which enable simple comparisons to be made between stranded and solid wire coils having either single or multiple-layer windings.

The Thirteenth International Navigation Congress.

THE thirteenth International Navigation Congress of the Permanent International Association of Navigation Congresses will, as we have already announced, be held in the building of the Institution of Civil Engineers on Monday, July 2nd, and following days. The formal opening of the Congress will take place at noon, and an address will be delivered by the President of the Association, the Right Hon. Lord Desborough, K.C.V.O., replies being made by the chief delegates of the countries represented. The afternoon will be devoted to sectional meetings, the First Section under the chairmanship of Lord Desborough, discussing "The Utilisation of Waterways for the Production of Power: Its Consequences and Applications;" and the Second Section, which will be presided over by Sir Ernest Glover, dealing with (1) "The Accommodation to be Provided for Ships in Connection with the Construction of New Works at Ports in Order to Satisfy the Future Dimensions of Ships," and (2) "Types of Works for Berthing Ships of Great Draught in Tidal Seas." In the evening there will be an official dinner to members of the Permanent International Commission and chief delegates, and an official reception to delegates and members and ladies attending the Congress.

On the Tuesday morning at 10 a.m. Section I. will further consider "The Utilisation of Waterways for the Production of Power: Its Consequences and Applications," and in the afternoon will direct its attention to "Dispositions or Arrangements to be Adopted for Locks, Elevators, Inclined Planes, and other Means of Overcoming Differences of Level with a View to Facilitating Operations." Section II. will devote the whole day to further consideration of the two subjects on which it was engaged on the previous day. In the evening a dinner will be given by the British Organising Committee to the delegates and members of the Association (and ladies) attending the Congress.

During the morning of Wednesday, July 4th, Sections I. will continue its deliberations on the question of methods of overcoming differences of level, while Section II. will discuss:—"The Relative Advantages of Ship Equipment for Loading and Discharging Ships;" "The Mechanical Equipment of Ports and the Mechanical Handling of Freight;" and "Loading, Discharging and Carrying Between Ships and the Various Depositing Points, whether Covered by Sheds or Not." In the afternoon, after being entertained at luncheon by the Corporation of Trinity House and the London Chamber of Commerce, the party will visit the Port of London Authority.

The matters to be considered by Section I. on the Thursday are:—(1) "The Influence of Surface Waters and Subterranean Sheets of Water on the Flow of Rivers. *Régime* of Mixed Canals; Estimation of the Water Consumed for Navigation and Irrigation Uses; the Portion Returned to the Subterranean Sheet of Water;" and (2) "Unification of Statistics of Inland Navigation with a View to Facilitating the Comparison of the Results of the Working of Navigable Waterways in Various Countries." Meanwhile Section II. will continue in the morning its consideration of the relative advantages of ship equipment for loading and discharging ships, &c., and in the afternoon will discuss:—(1) "Concrete and Reinforced Concrete: Their Applications to Hydraulic Works; Means to Ensure their Preservation and Water-tightness;" and (2) "Use of Liquid Fuel for Navigation and its Consequences." In the evening, from 4 to 6 p.m., there will be a reception at the Mansion House by the Lord Mayor of London.

On the morning of Friday, July 6th, the Ocean Navigation Section will have the following subjects before it:—(1) "The Utilisation of Tides for the Production of Power for the Working and Lighting of Ports and for Maritime Works, Working of Lock Gates, &c.;" and (2) "Principal Advances Made Recently in Lighting, Beaconing, and Signalling of Coasts. Standardisation—Unification—of the Languages of Maritime Signals." In the afternoon there will be a general meeting of the Congress to adopt and record resolutions on the various questions and communications of the Sections.

On Saturday, July 7th, the party will visit Windsor Castle, and on the Sunday a visit will be paid to the river Thames and Taplow Court, at the invitation of Lord Desborough.

The Monday, Tuesday, and Wednesday of the following week will be devoted to visits to Southampton, South Wales, Manchester, Bristol, and Liverpool.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Pig Iron Weakening.

PIG iron is hardly maintaining its position, though the deterioration is in this district more a matter of market tone than of a new price level. Though definite reductions have taken place in other districts, no concerted movement has been made by Midland smelters. The comparative small demand for forge material has, however, eased prices a little, though there is very little stock of this iron, either at the furnaces or in the makers' hands, and there is no disposition to press the material on the market. Undoubtedly, some local furnace owners are willing to accept lower prices, both for forge and foundry quality iron, to-day than they would have entertained a month ago. Others, however, adhere to the old quotations of £5 for forge and about £5 10s. for Derbyshire foundry. For Northamptonshire forge iron something less than £4 17s. is mentioned, and No. 3 foundry has changed hands down to £5 5s. There is little new business, but Northampton and Derbyshire makers state that they are continually being pressed for deliveries. Orders are being worked off, but sellers are confident that various customers, such as ironfounders, who have not been buying lately, must come forward shortly with new business. The principal factors in the pig iron situation continue to be the scarcity and high price of furnace coke, which remains very firm at 30s. and upwards at ovens. This makes it impossible to bring more plant into operation. The industrial conflict in Belgium and the march of events in the Ruhr are being closely watched by producers and consumers alike in view of their relation to the market here. The South Staffordshire ironworks are at the moment making but poor demands on the pig iron industry.

Effect of Belgian Competition.

Belgian makers of No. 3 iron, suitable for the Black Country nut and bolt industry, are making every endeavour to get once again into this market. Again this week they have reduced their quotation by 5s. per ton. Darlaston nut and bolt manufacturers have received many offers at £7 15s. f.o.b. Antwerp, which works out at £9 delivered here. With production costs stationary, Staffordshire mills do not pretend to keep pace with the continental depreciation, but there has been some further readjustment in prices, business having been done at £11 5s., or 2s. 6d. less than the minimum last week, though £11 7s. 6d. is the more general quotation. Lancashire houses cannot come to these figures, their price being £11 12s. 6d. and in some instances £11 15s. However, for a particularly attractive specification they might be prepared to accept £11 10s. There can be no doubt but that the continental developments are a growing menace, and with a difference of 45s. to 50s. between foreign and native prices, consumers who are none too well off for work and who have to meet keen competition, cannot be blamed for taking advantage of the cheaper material. Whether Antwerp shippers are getting much response to their offers does not appear to be generally known, but unless Staffordshire prices are still further reduced, there can be no doubt but that the foreigner will secure an increased share of the small business which is now coming on to the market. Marked bars continue in fair demand at £14 10s., and makers are fairly well employed. Crown bars continue to be quoted £12 10s., but in some instances £12 5s. has been accepted by Staffordshire makers. There are other makers, however, who claim to be obtaining £12 15s. for best quality merchant bars.

Galvanised Sheets.

The Staffordshire mills devoted to rolling galvanised sheets have plenty of work on hand and are maintaining slightly higher quotations than those of South Wales makers. Galvanised sheets of 24 w.g. are selling locally at from £19 7s. 6d. up to as much as £19 15s. South Wales makers quote £19 5s. to £19 10s. f.o.b. in bundles. The reduction of sheet bars to £8 10s. —a substantial drop from recent rates—has brought some slight concessions in black sheets.

Steel Values.

Midland steel works continue to be well employed, and have a fair amount of foreign business on their books. Values remain much as last week. Standard prices for finished material are still maintained by the large steel works, who have fair reserves of orders, in some cases sufficient to keep the mills at work until the end of July. Continental finished steel, although offered, is not coming over here in large quantities. It can be bought at £7 17s. 6d. Antwerp, equal to £9 2s. 6d. delivered here, a figure well below native prices. But more advantage is being taken by English merchants having customers in the Eastern or South American markets, and an appreciable saving is effected by shipping this material direct from Antwerp. Re-rolled steel is easier, following the reductions in the price of billets. Producers continue to quote £8 15s. upwards for soft billets, though it is claimed that if an attractive tonnage is called for £8 10s. would be accepted. Certain firms still quote £9 for welding billets. Belgian exporters continue to make bids for the market, and this week are offering billets at £8 5s. delivered here. Hitherto, local makers have been able to hold their own, but they are now being undersold. Mills at home have, however, already filled the principal requirements for the time being, and they are more or less indifferent to these movements by Antwerp shippers. Consumers hold to the opinion that by the time their present contracts run out they will probably be able to get more favourable terms than any that are now open to them. Steel bars continue to command about £11. Steel strip is in the neighbourhood of £11 10s., or 25s. to 30s. less than iron strip, and is accordingly preferred for tube making, unless iron is stipulated for.

Scrap.

The scrap market continues demoralised, and it is difficult to get a definite price for steel scrap. Prices have fallen heavily, and there is a wide divergence of view between buyers and sellers as to values. Holders of scrap want as much as £4 5s. free on rail, but consumers are demanding delivery of this material at £4 or under. The Siemens furnaces apparently are adequately supplied, and disposed to wait for still lower prices. Transactions are strictly to meet urgent requirements. A lot of foreign material is coming in at prices substantially below English quotations.

Constructional Engineering.

There is a fair amount of constructional work being carried through by Midland engineers, though large undertakings continue for the most part in suspense, in view of the desire to test the stability of present prices before giving out expensive contracts. Constructional engineers in this district complain that owing to the reduction of steel prices in Scotland and by certain firms in the North of England, they are handicapped in competition, a general estimate being that when the cost of carriage is considered they are at least 10s. worse off than their competitors in Scotland and on the North-East Coast. The local steel works are still asking £10 10s. for joists and sections, though in special cases some firms are stated to have accepted £10 5s.

Coventry Engineering.

The engineering branch of Coventry's trade is holding its own. Further Government contracts have been secured which will provide employment of a more lasting character for certain works than would have been the case if the seasonal motor trade alone had to be relied on. All sections of the motor industry are busily engaged on production for the home market, and the pedal cycle remains a bright feature. Electrical firms who have had a good run on wireless receiving sets are feeling the effect of foreign competition, component parts ready for panel mounting being placed on the market at a price less than the cost of the raw material to local firms. In consequence of this and the general uncertainty of the position regarding wireless, important developments that were under contemplation in Coventry are for the time being held over.

Malleable Iron.

The British Cast Iron Research Association has now organised a wide research into every aspect of malleable work, and is appealing for the support of those engaged in the trade to carry the enterprise through. It is proposed to publish the results of the laboratory investigations in such form as will enable them to be applied commercially. In some of the 231 malleable foundries in Great Britain, the practice is much more advanced than in others; but the time has undoubtedly come when a decisive effort must be made to raise the common standard to much higher efficiency, and research is the starting point. As the malleable iron industry is carried out in this country, few individual foundries would find it practicable to pursue independent research work. There are, however, well-staffed laboratories at their disposal at Birmingham and Sheffield for those who wish to avail themselves. What they could not do individually may be done co-operatively, and it is much to be desired for the future good of the industry that the necessary backing will be given to the Association to enable Dr. Percy Longmuir, the Association's director of research, and his collaborators to go ahead collecting the scientific data from which the practical objectives must be determined.

Transport by Canal.

The question of improving canal navigation from Birmingham to the sea, which is of the utmost importance to industrialists and manufacturers generally in the Midlands, has been advanced somewhat this week by the appointment, subject to the approval of the City Council, of a special committee with authority to spend £1000 in securing expert advice and of meeting the cost of any inquiry it may make. It is desired to discover which of the three schemes from Birmingham to the sea—by way of the Severn, the Mersey, or the Thames—it would be wisest in the interests of industry in this district for the Council to embark upon.

Miners' Wages Agreement.

Though the majority of coal-mining districts are in favour of terminating the national wages agreement, which is one on a profit-sharing basis, the miners of Cannock Chase are in favour of its continuance, and at the meeting of the Miners' Federation this week their vote was cast on the side of "no change." Cannock Chase has had little to grumble at from the working of the agreement, for on a number of occasions it has found itself receiving increases of pay, in common with other coalfields in the eastern area, when many thousands of miners in other districts were outside the scope of such advances. Cannock Chase has benefited by being linked up in the wages ascertainment scheme with a big district like Yorkshire. If the present agreement is scrapped and the wages are regulated on the costs of the industry on the Chase alone, it is certain that an unpleasant and unwelcome drop in Cannock Chase miners' wages would result. The miners in this district cannot be said to be content with the full workings of the existing agreement, but they consider it unwise to part with it until there is something better to put in its place.

Unemployment Still Decreasing.

The steady decrease in the number of unemployed registered in the Midlands area is maintained, the latest figures issued showing a total of 151,037, as against 152,680 the previous week, or 1643 fewer. Birmingham records the biggest decrease with a drop from 41,114 to 40,492, the other principal decreases being Derby 201, Northampton 186, Walsall 185, Dudley 171, Cradley Heath 151, West Bromwich 138, Bilston 118, and Coventry 85.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

THE markets here have not yet shaken themselves free of the holiday influences and general business remains very quiet. There seems still to be a belief that prices are not altogether safe for buyers, and as a consequence the consumer is apt to restrict his purchases to what is wanted for immediate use. There is no general disposition to enter into far-reaching transactions, and very little inclination to speculate. The slight disturbance caused by the political changes seems to be passing away, as it is recognised that the new Ministry will be very much the same as the last, and that no change in policy is at all probable. There would, no doubt, be more satisfaction in business circles if the Russian dispute were brought to an end, and a slackening in the export demand for fuel would be welcomed by the iron and steel trades. There is, in fact, a lesser demand on the collieries and coke ovens, but it is uncertain yet whether this is not caused by the temporary congestion of the shipping ports and not by any actual falling off in the continental demand.

Metals.

The demand here for the non-ferrous metals is decidedly not good. There are very few buyers about, but, of course, this may be because they have all been away from business for a week, and will want a day or two to pull themselves together. The slight upward movement in copper which took place recently does not seem to have yet inspired confidence as to the future. The very wide gap between electrolytic and best selected ingot may be taken as a proof that the engineering consumption of copper is not what it should be. No doubt for certain purposes electrolytic copper is more suitable, but the actual difference in intrinsic value is quite trifling; and yet the one kind is quoted at about £5 per ton more than the other. The real difference in value is probably nearer 5s. The official quotations for manufactured copper and brass are much as they have been for a long time. There is as yet no indication that manufacturers are disposed to assist the engineering trades by a lower level of profits. The old motto of "small profits and quick returns" seems to have gone completely out of fashion in this section of industry. Old metals are still fairly cheap, more especially when one judges by the prices which dealers are offering when it is a question of buying and not of selling. Few dealers in this district will pay more than £48 per ton for good lots of gun-metal scrap and £40 for heavy yellow brass scrap. Engineers who are not bound down to a definite specification may therefore obtain their gun-metal at a fairly low figure. The conservatism of the dealers in scrap is a very good index of the state of trade, for if this were improving we should find the dealers tumbling over one another to buy non-ferrous scrap. The general position in the tin market remains very uncertain. We are back at fairly reasonable prices; that is to say, in relation to other metals, but the fluctuations have been rather violent and may be so again. It seems impossible to get at any reasonable cause for such variations, for the general position does not alter very much from week to week. There seems to be a belief that America has some considerable buying yet to do, and some people are hoping that this will strengthen the market again and cause another advance; but the whole outlook is too uncertain to allow of any prophesying. Lead has kept fairly steady after the advances which occurred in the middle of the month. The demand has, however, been quieter of late and the prompt price has sagged a little. Spelter has been a very quiet market, and it is clear that the demand from the British galvanising trade is not what it should be. The price of spelter is, however, much more moderate in comparison than the price of lead.

Pig Iron.

The markets for foundry iron here are still very quiet, and there is but little business passing. Actually business has scarcely begun yet after the holidays, but the feeling on the part of consumers is still that much lower prices must soon prevail, and they are simply waiting for the sellers to give way. The further weakness in the Cleveland iron market to-day supports this theory, for it is clear that the makers on the North-East Coast are now trying to get home orders, which means that the export trade is beginning to fail them. Of course, the Cleveland prices are still much too high for Lancashire; but it may be that later on makers will try to regain some of the more northerly Lancashire trade, and this will mean a lessening of the Lancashire demand for the Midland irons. Hence the consumer here believes that he has only to wait and lower prices for foundry iron will come about naturally. At present the Derbyshire makers are quoting from 113s. to 115s. 6d. per ton for No. 3 foundry iron delivered in Manchester, but only a few odd lots are being sold. Merchants would, no doubt, shade this price considerably if there were buyers for forward delivery. The price of Scotch iron here is again a little easier, but it is still too dear for the ordinary ironfounder, and very little business is possible in it. Hematite pig iron is fairly steady.

Steel.

The market for manufactured steel remains irregular. It is clear that some sellers are anxious for orders, and these quote rather lower prices; and merchants also are inclined to cut the price a little. Steel plates are quoted from £10 5s. to £10 15s. per ton, and round steel bars from £11 5s. to £12. For angles and joists about £10 per ton is usually quoted, but a little less might be taken.

Scrap.

The market for scrap material remains depressed and the prices are low. For cast scrap very poor prices are heard of down to 80s. per ton, but the stronger dealers here will not sell at such low figures. One can, however, buy good cast scrap at 90s., and this is 25s. below the nominal price for common pig iron. Wrought scrap is

less in demand owing to the lesser sales of manufactured iron. About 92s. 6d. to 95s. per ton seems to be the value. Heavy steel scrap is not worth more than 90s. on trucks in Lancashire.

BARROW-IN-FURNESS, Thursday.

Hematite.

There is more life noticeable in the hematite pig iron trade and more business is being done, but not to a very marked extent. Still, this is a sign of more activity. The orders being placed are for delivery within the next four months or so. There may be some customers who are holding back for further reductions in price, but they are likely to be disappointed. Not only does the trade with this country show an improving tendency, but there are distinct signs of continental buyers having to come into the market. America continues to be a customer, but not to the same extent as some time ago when the iron trade in that country was dislocated by the coal strike. Makers are not short of orders, having regard to the number of furnaces in blast, and if the coke supply would improve and be more reliable some more furnaces might be put in blast, but that is impossible when the coke supply is hand-to-mouth.

Iron Ore.

The iron ore trade continues to be fairly well employed, particularly in Cumberland. Most of this ore is being consumed at local ironworks, but small quantities are sent to Scotland and the East Coast. Occasionally there is a part cargo for the Continent. Foreign ore is in moderate demand, and the imports at present are not heavy.

Steel.

The steel trade is about the same. The amount of trade being done is not heavy, and high prices still keep some customers off. The Barrow rail mills are working, as also are the hoop and the small bar mills. Foundries are only fairly employed, but are hoping for better trade in the early future. The Moss Bay Company has secured an order for rails which will employ the mill for a few weeks.

Shipbuilding and Engineering.

The boilermakers' dispute is causing a delay in some of the departments at Vickers' works, and the sooner the executive arranges for the men to re-start and withdraws its opposition to the night shift and overtime agreement the better will it be for all concerned. The platers at Barrow who are affected by this dispute have held a meeting to protest against the action of the officials, and have recommended that negotiations should be immediately opened with a view to re-starting. These men object to being forced to leave work without being allowed to express their opinion.

SHEFFIELD.

(From our own Correspondent.)

The Busy Open-hearth Furnaces.

THE condition of the steel trade in Sheffield and district does not improve, but rather shows a declining tendency. The pressure of work at the open-hearth steel furnaces, however, continues. The large plants at Steel, Peech, and Tozer's, Samuel Fox and Co.'s, and the Park Gate Ironworks, are still running full time, and turning out huge tonnages of material, although it must be admitted that even here the indications of continued activity are not as good as they were. Prices are firmly held. The furnaces referred to are of the basic character. The acid steel branch, which did not begin to improve until some time after that devoted to basic products, has been the first to fall off, and its output is still tapering away. The wire trade of the country as a whole is very good, and makers are finding that they can do better by obtaining their raw material from Sheffield than by going to the Continent for it, as they did before the war. The huge new wire rod mill at Templeborough, near Rotherham, has been running full time since the beginning of the year.

Ruhr and the Engineering Trades.

It is in the departments devoted to engineering, and to the supply of engineers' requisites, that one finds the most unsatisfactory conditions prevailing. The chairman of Vickers, Limited, at the annual meeting last week, explained the situation very succinctly. The reduced production of coal and steel in the Ruhr district, and its diversion from its natural course, had, he said, led to the increase of prices of coke, coal, and steel here, with the natural result that the cost of ships and engineering products had risen to a level which held off buyers who had not already been frightened away by the uncertainty of the political situation. "Coal and coke companies," he continued, "and makers of raw steel of ordinary qualities have gained a passing advantage, but on the whole the French occupation of the Ruhr is causing a considerable loss to the engineering trades of this country." The heavy engineering and machine tool trades are exceptionally quiet. There is some improvement in saws and a variety of small tools, and some large contracts for files have been booked lately, but the prices for these have been very severely cut.

Railway and Wagon Work.

The railway steel departments continue to do well, and among the orders which have come in lately for axles, tires and springs are some good ones for South America. There is also a large amount of work on hand for the home railway companies. On the other hand, the activity due to the building of wagons for private owners—which was a considerable share of the whole—is falling off. In this department there was quite a boom in the early part of the year, but the pendulum has now swung back almost to the opposite extreme. It is the rise in iron and steel prices which has caused the situation to change so seriously. The old contracts—taken at prices which left little or nothing in the way of profit—are now completed, and in consequence of current quotations wagon owners are withholding their further orders. It is believed, however, that this condition cannot last, in view of the great shortage of wagons in the country. Builders state that requirements are so large that the whole of the existing sources would be taxed to meet them.

Light and Shade.

At the works of Hadfields, Limited, there is a good deal of activity, mainly as regards colliery equipment, and employment is found for a large number of hands. The Prince of Wales, during his visit to Sheffield on Tuesday, started a new 28in. rolling mill at the East Hecla works of this firm. The mill is electrically equipped, and is provided with all the latest improvements and labour-saving devices. The state of the crucible steel trade remains very unsatisfactory, and not many of the plants are melting more than two days a week. Conditions, it will be seen, are very much mixed, and, generally speaking, the trend of trade movement is adverse. At the same time, the unemployment figures in the city continue to fall by a few hundreds per week, and the total, according to the latest report, was 26,585, a drop of 530. An explanation seems to be that a minority of favoured firms are doing well. There are reasons for supposing that the export trade of the city is, on the whole, improving. The certificates of origin issued by the Chamber of Commerce shows a steady increase. During the past eight or nine months the number has progressed from 100 to 300 per month, and the figure for May exceeded 400.

The Cutlery Trade.

In the cutlery and plate trades there is no general improvement. While some houses are doing fairly well, others continue very short of work. Some good orders continue to come in for restaurant and hotel use, and for very cheap lines. One firm has secured a very useful colonial order for 50,000 spoons, 50,000 forks, and 25,000 knives.

Vickers' New Enterprise.

Some interesting statements as to the way in which a great firm is adapting itself to new conditions were made by Mr. Douglas Vickers, chairman of Vickers, Limited, at the annual meeting of the company last week. He mentioned that among the ships which the company is now building is one fitted with internal combustion engines of the firm's own type. These engines, he said, which are the result of application to merchant ships of the company's very large experience gained in the construction of engines for submarines, have shown great reliability and extremely economical results in actual work. It is probable that a large number of future ships of moderate size will be fitted with this type of engine in preference to the steam engine. In consequence of this, the firm will have great difficulty in filling up the boiler shops at Barrow with work, and it has decided to break into a new field, the manufacture of land boilers. It has, therefore, acquired a substantial interest in the Spearing Boiler Company.

A Huge Electrical Unit.

The Prince of Wales, during his visit to Rotherham, on Monday, formally opened the new electrical power station of the Corporation, and started up the principal electrical set installed. The station has been under construction for several years, and is now ready for full duty. Its erection and equipment have involved an expenditure of upwards of one million sterling. The department supplies current to a large number of industrial works in its area, the greater proportion of which have been electrified, and also provides power for tramways. It has, moreover, to meet a rapidly growing demand for electricity for domestic purposes, and has at present 3500 consumers connected. Rotherham claims to lead the world in its average consumption of electricity, the sales being at the rate of an average of 650 units per head of the population. The record was previously held by Detroit, with 600 units per head.

Mammoth Range of Furnaces.

I have frequently referred to the great new installation of basic steel furnaces at the works of Messrs. Steel, Peech, and Tozer, Templeborough, Rotherham—a range which was put down during the war, and which, although idle until recently, has this year fully justified its existence, and is now one of the busiest plants in the country. This installation was also visited by the Prince of Wales. It consists of fourteen 60-ton open-hearth furnaces, and its magnitude may be judged from the fact that the stage or platform in front of them is a quarter of a mile long. Attached to the furnaces is a 36in. cogging mill for rolling 3-ton ingots into 6in. blooms, the cogging down being completed in sixteen passes at the maximum rate of 120 tons per hour. The cogging mill is electrically driven, and the intallation is unique as far as this country is concerned.

NORTH OF ENGLAND.

(From our own Correspondent.)

Idle Markets and Falling Prices.

ALTHOUGH there is no real deterioration in the general industrial position in the North of England, the resumption of business after the holidays has not brought the hoped-for expansion in trade, and the present position cannot be regarded as other than unsatisfactory. Without exception the markets have begun to sag, and as always in such circumstances traders are holding off until the last possible minute. The unsettled state of the money market and labour troubles abroad, as well as the unsatisfactory position of the Ruhr question, are the factors which are having an adverse influence on the trade situation.

Cleveland Iron Trade.

The Cleveland pig iron trade presents few new features. Business has fallen away almost to nothing, and the market is badly in need of a fillip. The trade position, however, is fairly good. The consumption of pig iron is just as great as it was, say, two months ago, and it is felt that if stability can be restored to the market business would soon be proceeding along more or less normal lines. Makers are willing to cut prices so far as they can to get orders, but that is a process which can only be carried to a limited extent. There may come a point when it will pay better to reduce output than reduce prices. Possibly that point has not yet been reached, but until coke is cheaper pig iron cannot be profitably produced at present selling prices. Still, buyers are holding off. It is the usual experience on a falling market, but if anything were to occur to stop the downward tendency and divert prices on to the upward curve everyone would be clamouring for supplies. One hopeful sign is that there has been a little inquiry on foreign account, but Cleveland now finds it difficult to get orders in competition with other areas, where iron is offered at lower rates. Even though No. 3 G.M.B. Cleveland pig iron is now selling at 120s. per ton, it is still dearer than either Scottish or Midland foundry iron. That is one of the hard facts which cannot be ignored, and so long as these circumstances continue Cleveland can scarcely look for active trade. The scarcity of No. 1 foundry keeps the price at 130s., but all other quotations are reduced, No. 4 foundry being 117s. 6d., and No. 4 forge 115s. per ton.

Hematite Pig Iron.

The weakness of the foundry iron trade has also extended to the hematite market, and whilst some of the makers continue to quote 122s. 6d., mixed numbers are now obtainable at 120s., and No. 1 at 121s. per ton. There is, however, a fairly steady sale of hematite, and the whole of the output is passing into consumption.

Iron-making Materials.

With all branches of the iron and steel trade slack it is not surprising to find the foreign ore trade in a state of idleness. Imports under running contracts are heavy, but new business is practically unprocurable, and the price of best Rubio ore is purely nominal at 24s. 6d. per ton c.i.f. Tees. The export price of coke is easier, and although there has been no corresponding fall in home prices, it is hoped that at least this will mean less restricted supplies to the furnaces. As yet, however, there is little perceptible change, and 45s. per ton is still the generally quoted price of good Durham medium furnace coke delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade is utterly lifeless at present. The rush for rail orders seems to have petered out, and there is an all-round slackness in trade. Hoping for price cuts, buyers are holding off, and as foreign semi-steel is so much cheaper than British, a cut in the price of billets would occasion no surprise. But all other prices are firmly maintained, even though orders are scarce, and makers assert that they are already so low as to preclude any chance of reductions until cost of manufacture falls.

The Coal Trade.

The Northern coal trade has taken on a decidedly quieter aspect in most directions, and, as a rule, the recent quotations can be substantially discounted, though at present not much business is being actually transacted. The reaction is said to be almost entirely restricted to the prompt market, but there is no gainsaying the fact that forward figures are being materially influenced. Though little or nothing is being done forward at the moment, merchants and exporters are not likely to look at some of the prices which have recently been paid. It is more than likely that when the collieries are again definitely seeking for trade they may have to modify their ideas of prices. Just at present, however, most of them are well stemmed for the whole of June. There are, of course, disturbing factors which are influencing the trend of the market. Chief among these is the political unrest on the Continent, which, added to the effect of continental strikes, has resulted in the export section easing down. There is also the competition of Cardiff, Yorkshire, Scotland, and even America to contend with. One important American shipper made the statement this week that their c.i.f. price for North Europe was actually lower than the f.o.b. prices here in some cases, while for Italian business the competition is keener than ever. Northumberland steam coals are all on offer, and are weak at slightly lower prices. Durham classes of coals are not quite so badly hit by speculators as steams, yet there has been a slight relapse, and for any kind of gas coals lower prices are now offered. Bunkers are inclined to ease to a certain extent, and can be discounted a little. The coke market is firm for every make of furnace and foundry, while gas coke is in good demand and is firmer all round.

SCOTLAND.

(From our own Correspondent.)

Easier Markets.

AN easier tone is noticeable in the steel, iron and coal markets. Prices may not show much alteration in some directions, but the downward tendency is there all the same, and, wherever possible, makers are inclined to meet buyers. In one or two districts, notably Greenock and Motherwell, trade is comparatively brisk, but, generally

speaking, demands for all classes of materials are lagging, both on home and export account.

New Contracts.

One or two contracts of considerable interest and importance have just been announced. Babcock and Wilcox, Limited, Renfrew, have received an important contract in connection with the electric power extension of the Victoria Falls Power Company, Zambesi; Sir Wm. Arrol and Co. (Limited), Glasgow, have secured the contract for a new graving dock to be built by T. W. Greenwell and Co., shipbuilders, South Dock, Sunderland; Harland and Wolff, Govan, have orders to build three new twin-screw internal combustion vessels, 420ft. in length, for Andrew Weir and Co., Glasgow, in addition to three single-screw motor ships, 380ft. long, already ordered by the same owners. The machinery for all six vessels will be constructed at Harland and Wolff's Diesel engine works in Glasgow.

Steel and Iron.

No change of importance has taken place in the Scotch steel and iron trades during the past week. In all the various descriptions of materials, buying is extremely modest and present indications point to still quieter conditions. The high levels of prices maintained by producers against the weaker tendency of the markets, and also the possibility of increased offerings and better deliveries of continental materials, have caused buyers to withhold everything in the shape of an important order that could possibly be kept back. Many works are, of course, still well employed on orders booked some time ago, but there is little immediate prospect of further business of importance to follow when these contracts are worked off. Trade disputes are interfering with progress in shipbuilding, but even if employment were uninterrupted it is questionable if many orders would be placed at the present cost of production. Steel sheet makers are busy, and a fair amount of new business is mentioned, but plates and sectional materials are now extremely slow. Bar iron, too, has fallen off in demand, and forward bookings would be welcomed. The highest level of prices for manufactured iron has meant an increase in workers' wages, but prices are being reduced, the quotation for "Crown" bar iron being now 10s. cheaper at £12 per ton delivered at Glasgow. Makers are also becoming concerned at the lack of fresh orders in the re-rolled steel section of the industry. The trend of trade is reflected in the dulness in the scrap market. Practically all classes of scrap are now plentiful and easier in price, and with consumers fairly well covered further orders are held back pending still easier quotations.

Coal: Quieter Export Demands.

The falling tendency of coal prices is becoming more pronounced. Some collieries have a considerable amount of work to overtake, but others are not so fortunate, and with orders for June of a very light description quotations are irregular and likely to become considerably cheaper. German demands are slacker, and the same applies to almost all foreign business. Offers of second-hand fuel have again been frequent, but transactions are not extensive. Washed materials seemed to be holding their position fairly well, but these have now also joined in the downward tendency. The pressure at the Firth of Forth ports has slackened off and the loading turn is now pretty regular. Aggregate shipments from Scotch ports during the past week amounted to 290,438 tons, against 342,235 in the preceding week, and 273,911 tons in the same week last year. The Finnish State Railways have placed a contract with a Glasgow firm of exporters for 40,000 tons of West of Scotland and Fifeshire screened steam coal to be shipped over June, July and August at the price of 35s. per ton c.i.f. This, apart from an order of 8000 tons placed a few months ago with the same firm, is the first contract placed in Britain on behalf of the Finnish State Railways for steam coal since 1914. The home market for coal is, if anything, quieter than the export department. Industrial orders are very easily satisfied, and only best qualities of house coal show any special activity. Many large orders, some in connection with municipal undertakings, are being held over until the future level of prices is more clearly defined.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

UP to the middle of this week the steam coal trade had not fully recovered from the holiday effects, and the shortage of coals entailed by the suspension of work at the collieries during the first half of last week. The position is very much what was anticipated inasmuch as there was a good deal of tonnage held up over the vacation, and coals have not been forthcoming since to meet the demand. The docks are practically full of steamers, but during the latter half of last week and the first few days of this week there were tips idle owing to there being an insufficiency of coals to keep them going. The situation is improving, but there will be very heavy loading pressure for the next three weeks or so. Actual business during the past week has been very small for the reason that the collieries have not got the coals for sale for anything like prompt shipment, and buyers are not purchasing ahead unless they can materially discount present prices which, however, coalowners are not prepared to do at the moment. There are better inquiries than was the case a few weeks ago for supplies over the second half of the year, but buyers' ideas are very different from the current prices prevailing. While superior Admiralty large are in the neighbourhood of 40s., buyers are endeavouring to arrange for supplies over the second six months of the year at something like 7s. 6d. per ton less. There is no eagerness on the part of sellers to do business on this basis. Small coals are scarcer even than large coals, and the inquiry for them keeps active. It is reported that one French inquiry on the market is for 120,000 tons of coking qualities for delivery in about equal monthly quantities over the second half of the year. There are also inquiries for about 15,000 tons of locomotive coals for the Swedish State Railways for fairly early shipment.

Labour Items.

The course of action which the miners' delegate conference at Blackpool decides upon is awaited with interest in this district. South Wales is one of the districts which has recommended that the wages agreement should be terminated, and last week-end the miners in the various districts were still passing resolutions instructing their representatives at the Blackpool conference to vote in favour of the Miners' Federation giving three months notice, their view being that under the agreement as it at present stands there could be no permanent increase in wages. Meanwhile, the non-unionist campaign is proceeding in various areas of South Wales. The miners of Abercrave and Llwynhafrod anthracite collieries in the Swansea Valley resumed work on Saturday after a few days' strike, and the notices tendered a fortnight ago by the Merthyr and Dowlais men are not being acted upon for the time being; but the miners employed at the Powell Tillery Company's British Colliery, Talywain, struck work on Monday as a protest against the employment of non-unionists. The relations of craftsmen with the Miners' Federation was discussed last week at the annual national conference of colliery enginemen, stokers and mechanics at Swansea, when it was pointed out that the National Federation of Enginemen is not opposed to the establishment of good and amicable relationship with the miners in all coal districts, and is willing to enter into and co-operate with the miners nationally or locally, provided their own rights as classes and colliery workmen were reasonably recognised by the miners; but they claim to be at liberty to organise within their own limits, to negotiate for the interests of their grades and classes and to reserve to themselves the right to determine their own course of action in relation to stoppages of work.

Trouble in Steel Trade.

Hopes are entertained that trouble will be avoided in the Siemens steel trade, but it is by no means certain. The locomotive men who hold a key position have held irregular meetings, and recently set up a claim for an advance of 15s. per week for drivers and 14s. for shunters. Without obtaining the sanction of their unions the men tendered a month's notice. These notices expire on Saturday next and a stoppage of work is, therefore, threatened at Margam, Briton Ferry, Ponterdawe, Duffryn, Cwmfelin, and Richard Thomas and Co.'s. The locomotive men at the Llanelly steel works also tendered a week's notice on Monday of this week, with the object of enabling them to stop work also on Saturday. The employers are understood to take up the attitude that the notices must first be withdrawn when they may be be prepared to deal with the accredited officials of the men's unions.

Dock Extension.

The announcement was made at a meeting of the Cardiff Chamber of Commerce in the early part of this week by Mr. Daniel Radcliffe that when a deputation waited upon Mr. Felix Pole, the general manager of the Great Western Railway Company, was under the impression that each port wanted a new dock, and he was rather surprised at the unanimity of opinion amongst the members of the deputation that what they asked for was for one new dock at Barry, or, at all events, to the west of Cardiff. In view of recent colliery developments in the Maesteg district, and of probable further developments, it was considered that the interests of the coal trade would be best served by a new dock in the neighbourhood of Barry.

Current Business.

The tone of the steam coal market for supplies of coal for early loading is very firm owing to the collieries having so much tonnage in dock and due to arrive during the next week or two that they will have no coal to spare. Many collieries are, in fact, already over-stemmed and cannot add to their obligations before the second half of June. The position is so tight that it is difficult to say what values are exactly, as the amount of business actually being done is still of a negligible character. Nominally best Admiralty large are about 40s. to 42s. 6d., and second qualities are about 37s. 6d. to 40s. Monmouthshire descriptions are on much about the same level, while dry coals are well sold and keep very steady. Small coals are relatively firmer than large and are very scarce. Best qualities range about 30s. to 32s. 6d. There is not much if any change in patent fuel, but coke is easier and pitwood is also lower. Anthracite coals are slightly easier for prompt loading, though cobbles, nuts, beans, peas, rubbly culm and duff coals are rather short in supply.

Swansea Metal Exchange.

The tone prevailing in the tin-plate market is better. Business is rather more active. A meeting of the whole trade on Tuesday adopted a recommendation of the Stabilisation Committee to continue the scheme for a further three months.

THE INSTITUTION OF CIVIL ENGINEERS.

APRIL EXAMINATIONS, 1923.

PASS LIST (*INTERIM*).

(Subject to Confirmation by the Council.)

The results of the Examination held abroad will be announced later.

Preliminary (127).—J. G. Archer, G. Ashton, R. H. Austin, N. Auty, O. A. T. Baker, J. Bain, R. L. Barnard, L. Bennett, P. S. A. Berridge, J. Bertram, jun., W. J. Bineham, H. P. Bishop, E. F. Blackbourn, D. C. S. Bland, H. G. Bloss, R. G. Booth, T. L. Bowring, E. E. Box, F. Brown, D. V. Buck, A. N. Burgess, M. A. Butler, W. Butterworth, J. L. Chapman, R. Ll. Clack, G. E. Clift, H. F. Commerford, W. H. Corner, W. N. Crimp, E. G. Dale, J. Dalziel, F. T. Davis, W. G. Davis, J. P. Dockray, T. Donkin, H. D. Drummond, H. Eastman, G. Edwards, J. H. Ellacott, G. Ellis, T. E. Emmett, T. K. Foulkes, H. A. Furness, S. L. Furnivall, J. Gadsden, R. G. Gallien, C. B. Geake, F. C. H. Gibbings, A. W. B. Gill, L. H. W. Goodhind, F. W. Goodman, L. K. Granger, G. Gray, jun., T. V. Greatorex, P. A. Gutiérrez, T. D. Hackney, R. H. C. Hackshaw, M. C. Halton, A. Hargreaves, C. E. Hawksley, The Hon. G. A. R. Hay, D. Hide, N. B. Hodgkin, D. Holdsworth, H. E. Hopthrow, H. M. Horrocks, E. Howard, J. M. M. Howatt, G. Howell, J. H. Humphryes, C. R. Ingham, M. R. James, A. R. Jefferson, H. J. F. Kempthorne, G. R. Kettlewell, C. R. Kinton, J. W. B. Kirkland, N. Lamond, F. J. Lancaster, G. C. Law, R. H. Lowe, C. Lunn, W. B. Macfarlane, J. Mackie, A. J. Marshall, H. B. B. Marten, T. S. Martin, J. R. Mileson, T. L. Molyneux, J. L. Murgatroyd, R. S. Newbury, L. F. Nicholson, M. W. G. Overton, F. L. Pasley, R. Pearce, W. R. Perks, G. A. Phillips, C. R. Porter, C. A. Potter, E. B. S. Powell, A. W. B. Pullen, F. A. I. Purgold, S. G. Purkis, W. D. G. Rees, L. W. Roberts, W. L. Roberts, W. A. R. Robertson, A. M. Rosie, jun., C. Seel, J. Sewell, A. M. Shanks, D. G. Skitt, A. R. Smee, S. P. Squire, S. G. Squires, J. Strachan, A. G. D'A. Sugden, F. W. Taylor, S. T. Taylor, A. Tillotson, J. H. Todd, R. V. Trace, J. W. Turtle, C. E. Whitaker, J. E. Wilson, T. S. R. Winter, R. Wyllie.

Associate Membership (212).—*Whole Examinations, Sections A, B, and C* (9).—J. A. Banks, B. W. Budds, E. Courthope, W. Dickinson, M.C., H. H. Drew, H. Firth, R. E. Jenkins, H. R. Paton, G. F. Stacey.

Sections A and B only (40).—D. L. Anderson, S. J. Astbury, H. Atkinson, A. F. Baddeley, F. P. B. Beard, T. H. Beckett, E. D. McG. Cook, S. R. Crowhurst, S. J. Curtis, D. C. Farquharson, G. S. Findlay, T. P. Francis, J. R. Gammell, W. R. D. Glennie, G. M. Hall, I. Hey, R. B. Hilton, P. Hodgson, J. G. Kimber, R. W. Langham, F. W. Luke, E. McQueen, A. Naylor, F. G. Orrell-Jones, J. I. T. Owen, W. Parvin, J. Reid, E. A. S. Roberts, H. Russell, C. W. Seddon, W. H. Shinkfield, E. Simpkin, S. J. Slaughter, R. H. T. Smith, S. F. Spinks, F. J. Tansley, R. F. Tremayne, M. Wasfi, C. B. Watson, A. Williams.

Sections A and C (2).—C. W. Davis, C. Gray.

Sections B and C only (16).—E. S. Broadhead, H. W. Clark, F. G. Gorman, O. P. F. Hilton, R. U. Law, N. C. Little, S. H. Lloyd, H. A. Marston, A. L. Maylan, M. A. Muirden, C. Pearce, C. J. Pell, G. S. Thatcher, F. S. Vernon, R. A. Welling, B. Wilson.

Section A only (63).—J. L. Adamson, W. J. Allen, E. R. Ash, G. S. E. Barker, H. G. Bengough, H. J. Berry, C. Bown, W. C. Budd, H. V. Budgen, H. Burleigh, M. B. Buxton, D. MacP. Cameron, C. F. Chambers, J. W. D. Cook, J. H. C. Crawford, J. Dudley, W. J. Evans, W. Fidkin, W. F. Fletcher, K. L. Forster, R. C. Gibson, J. V. Hall, H. D. Harrison, R. S. E. B. Hart-Davies, D. G. Hemsley, J. T. Hillier, J. A. G. Howard, L. L. Huss, R. K. Innes, A. C. M. Jansen, J. O. Jones, L. E. Jones, E. L. Key, A. J. King, J. H. Knight, H. F. Lea, N. M. Lewis, J. McL. Lister, G. H. F. Lutter, J. H. McIlvenna, A. B. Newby, P. Porteous, J. T. Robinson, W. Russell, R. Schofield, H. C. Sharpe, T. F. B. Simpson, C. B. Smith, G. H. Stevens, S. Sweeney, J. O. Taudevin, H. W. Taylor, J. Taylor, S. M. Taylor, H. O. Vaux, E. H. Vick, N. E. V. Viner-Brady, W. E. C. Ward, A. C. Wardle, J. Watt, A. J. Weale, W. Ll. Williams, W. M. Wilson.

Section B only (43).—P. R. Alderman, G. M. Ashwell, H. Bailey, D. J. Barnes, H. Bone, T. Bowes, E. S. Bradley, W. A. Broom, J. W. H. Casinader, J. D. Daruvala, G. B. Dodman, O. R. Edge, R. Ellis, J. L. F. Fenwick, E. R. Fry, E. D. Grubb, J. G. P. Hamilton, R. Hudson, T. R. Humble, E. W. Keer, R. G. Keevill, C. M. Kerr, M. Lewis, S. Mahadeva, S. Majidullah, T. G. Marple, N. H. Michell, S. G. Murtaza, T. R. Nelson, E. O. W. L. V. Parisot, J. A. Parkinson, jun., J. W. Price, A. B. Richards, A. Scott, J. R. Seward, L. G. Smith, W. B. Smitz, R. H. Tangri, F. Thackeray, W. S. Thomson, J. V. Wallace, H. M. Whatley, A. Woodburn, jun.

Section C only (39).—E. F. Bates, G. W. Bonney, D. C. Brown, B.Sc., Eng. (Lond.), J. C. Brown, D. C. Burn, B.A. (Cantab.), J. S. Clitheroe, G. W. Cover, E. M. Ellis, A. C. Fairbank, P. J. Foster, W. Foster, C. H. V. Full, A. N. Gardiner, B.Sc., Eng. (Lond.), F. W. S. Hawtayne, B.Sc., Eng. (Lond.), R. Heywood, T. F. Hurley, B.Sc., Eng. (Lond.), E. F. Johnson, B.A. (Cantab.), H. H. Kelley, H. L. Kerr, B.Sc., Eng. (Lond.), A. W. Knight, R. B. Lindsay, B.Sc. (Belfast), P. St. L. Lloyd, J. Locking, J. P. McIntyre, C. MacKinnon, N. McPherson, B.Sc. (St. Andrews), R. Marriott, A. Moir, B.A. (Cantab.), N. R. Neal, H. D. Neop, J. Parkin, J. Shaw, B.Sc., Eng. (Lond.), H. W. Tee, R. W. S. Thompson, B.Sc., Eng. (Lond.), V. H. Tripp, B.Sc., Eng. (Lond.), R. P. Wallis, B.Sc. (Durham), D. Watson, P. J Wells, R. H. Wheatley.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

CHILLED CASTINGS, Limited, of 27, Mincing-lane, London, E.C. 3, informs us that it has acquired the Griffin rights for Great Britain and the Colonies which were formerly held by the British Griffin Chilled Iron and Steel Company, Limited (in liquidation).

WE are informed that the massive circular steel treasury door, weighing 20 tons, which is the first of its kind to be manufactured in this country and which formed a feature in the new industrial film taken at the works of Chubb and Son's Lock and Safe Company, Limited, and was recently shown throughout England, has now been sold, and will shortly be fitted as the main strong room entrance of one of the principal banks.

WE are informed that Vickers Limited have acquired a substantial interest in the Spearing Boiler Company, Limited, and that the name of the latter company will be changed to Vickers-Spearing Boiler Company, Limited. The directors on the new board will be:—Mr. A. H. Spearing, chairman; Mr. J. Kerr-Bock, of the Spearing Boiler Company, Limited; Mr. Douglas Vickers, chairman of Vickers Limited; and Sir Vincent Caillard, of Vickers Limited.

MR. SIDNEY SIMPSON, who formerly was on the Yorkshire Electric Power Company's staff, 1908–1919, latterly as assistant to the engineer and manager, Mr. W. B. Woodhouse, and has been since 1919 associated with Mr. J. E. Schofield, Bradford, and Mark Shaw and Sons, Limited, Huddersfield, announces that he has now commenced practice on his own account as independent consulting engineer in connection with steam production, heating, power and lighting. His office is at 9, Market-street, Bradford; telegrams, "Therm, Bradford;" telephone number, 6705 Bradford.

LAUNCHES AND TRIAL TRIPS.

TORR HEAD, single-screw steamer; built by Workman, Clark and Co., to the order of the Ulster Steamship Company, Limited; dimensions, 400ft. by 53ft. by 28ft.; 5200 gross tonnage. Engines, triple-expansion; constructed by the builders; trial trip, May 1st.

HADRIAN, steel steamer; built by Swan, Hunter and Wigham Richardson, Limited; to the order of the Tyne-Tees Steamship Company, Limited; dimensions, 295ft. by 40ft. by 25ft. Engines, four-crank quadruple expansion; constructed by the builders; launch, May 15th.

Current Prices for Metals and Fuels.

IRON ORE.

N. W Coast—	
Native	26/-
(1) Spanish	24/-
(1) N. African	24/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	24/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	6 7 6	—
No. 1 Foundry	6 1 3	—
No. 3 Foundry	5 16 3	—
N.E. Coast—		
Hematite Mixed Nos.	6 0 0	6 0 0
No. 1	6 1 0	6 1 0
Cleveland—		
No. 1	6 10 0	6 10 0
Siliceous Iron	6 5 0	6 5 0
No. 3 G.M.B.	6 0 0	6 0 0
No. 4 Foundry	5 17 6	5 17 6
No. 4 Forge	5 15 0	5 15 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge *	—	—
,, ,, Foundry	5 7 6 to 5 12 6	
(3) Northampton—		
Foundry No. 3	5 5 0	—
,, Forge	4 16 0	—
(3) Derbyshire—		
No. 3 Foundry	5 5 0 to 5 7 6	
Forge	5 0 0	—
(3) Lincolnshire—		
Basic	6 0 0 to 6 10 0	
Foundry	5 10 0	—
Forge	5 5 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	6 15 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best ,,	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	12 15 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	12 10 0	—
Best ,,	13 10 0	—
Hoops	15 10 0	—
Midlands—		
Crown Bars	12 10 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 5 0 to 11 7 6	
Gas Tube Strip	13 0 0	—

STEEL.

	(6) Home £ s. d	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates ¾in. and up	10 5	—
Sections	10 0 0	—
Steel Sheets, ¼in. to ¾in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	14 0 0	—
Joists	10 0	—
Heavy Rails	10 10 0	—
Fish-plates	14 10 0	—
Channels	9 5 0	—
Hard Billets	10 15 0	—
Soft Billets	10 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	10 0 0	—
Light ,,	12 10 0	—
Billets	11 0 0	—
Manchester—		
Bars (Round)	11 10 0 to 11 15 0	
,, (others)	10 5 0 to 10 15 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	10 7 6 to 10 15 0	
,, (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	13 0 0	—
Bessemer Billets	13 10 0	—
Hard Basic	10 15 0	—
Intermediate Basic	10 10 0	—
Soft Basic	9 10 0	—
Hoops	12 15 0 to 13 5 0	
Soft Wire Rods	13 0 0 to 13 10 0	
Midlands—		
Small Rolled Bars	11 0 0	—
Billets and Sheet-bars	8 15 0 to 9 5 0	
Gas Tube Strip	11 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	19 7 6	—
Angles	10 10 0	—
Joists	10 10 0	—
Tees	11 10 0	—
Bridge and Tank Plates	10 15 0 to 11 0 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/3 to 23/6
Block Tin (cash)	197 15 0
,, (three months)	197 10 0
Copper (cash)	65 2 6
,, (three months)	65 12 6
Spanish Lead (cash)	25 17 6
,, (three months)	24 15 0
Spelter (cash)	30 15 0
,, (three months)	30 2 6
Manchester—	
Copper, Best Selected Ingots	69 0 0
,, Electrolytic	74 0 0
,, Strong Sheets	102 0 0
,, Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 2¾
Lead, English	27 5 0
,, Foreign	26 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£50 0 0	18/-
,, ,, 1 p.c. ,,	£60 0 0	21/-
,, ,, 0·75 p.c. carbon	£70 0 0	22/6
,, carbon free	1/6 per lb.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese (per ton)	£18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£21 0 0 scale 6/- per unit	
,, Vanadium	16/9 per lb.	
,, Molybdenum	9/6 per lb.	
,, Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	12/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	24/-
,, ,, Ell	25/9
,, ,, Splint	26/- to 27/6
,, ,, Trebles	25/6
,, ,, Doubles	24/-
,, ,, Singles	22/6
Ayrshire—	
(f.o.b. Ports)—Steam	24/-
,, ,, Splint	26/-
,, ,, Trebles	25/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	23/- to 27/-
Screened Navigation	32/-
Trebles	26/-
Doubles	24/6
Singles	24/-
Lothians—	
(f.o.b. Leith)—Best Steam	26/6
Secondary Steam	24/-
Trebles	26/-
Doubles	24/6
Singles	24/-

ENGLAND.

(8) N.W. Coast—	
Steams	31/6
Household	46/6 to 57/6
Coke	48/-
Northumberland—	
Best Steams	28/6 to 32/-
Second Steams	27/6 to 30/-
Steam Smalls	20/- to 22/6
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	32/- to 34/-
Second	30/- to 31/-
Household	25/- to 28/-
Foundry Coke	70/- to 72/6

Sheffield—	Inland.	
Best Hand-picked Branch	32/6 to 34/6	—
Barnsley Best Silkstone	28/- to 30/-	—
Derbyshire Best Brights	25/6 to 27/6	—
,, ,, House	23/- to 24/6	—
,, ,, Large Nuts	20/6 to 22/6	—
,, ,, Small ,,	18/- to 21/-	—
Yorkshire Hards	22/- to 24/-	—
Derbyshire ,,	21/- to 24/-	—
Rough Slacks	12/- to 14/-	—
Nutty ,,	10/6 to 12/6	—
Smalls	7/- to 9/-	—
Blast Furnace Coke (Inland)		33/6 to 33/6
,, ,, ,, (Export)	f.o.b.	41/- to 43/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	40/- to 42/6
Second ,, ,,	39/- to 40/-
Best Dry Large	33/- to 40/-
Ordinary Dry Large	35/- to 37/6
Best Black Vein Large	39/- to 40/-
Western Valley ,,	37/6 to 38/6
Best Eastern Valley Large	37/- to 38/-
Ordinary ,, ,,	36/- to 37/-
Best Steam Smalls	30/- to 32/6
Ordinary ,,	27/6 to 30/-
Washed Nuts	35/- to 37/6
No. 3 Rhondda Large	37/6 to 38/6
,, ,, Smalls	32/6 to 33/6
No. 2 ,, Large	34/- to 36/-
,, ,, Through	30/- to 32/-
,, ,, Smalls	26/- to 28/-
Coke (export)	65/- to 70/-
Patent Fuel	40/- to 42/6
Pitwood (ex ship)	27/6 to 28/-
Swansea—	
Anthracite Coals:	
Best Big Vein Large	45/- to 50/-
Seconds	40/- to 45/-
Red Vein	32/6 to 35/-
Machine-made Cobbles	55/- to 60/-
Nuts	55/- to 60/-
Beans	45/- to 47/6
Peas	25/- to 26/-
Breaker Duff	12/6 to 13/-
Rubbly Culm	17/6 to 18/-
Steam Coals:	
Large	26/- to 27/6
Seconds	25/- to 26/-
Smalls	20/- to 22/-
Cargo Through	22/6 to 25/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(9) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

*Quotations extremely high and nominal.

French Engineering Notes.

(From our Correspondent in Paris.)

Production.

THE production of pig iron is still only about 60 per cent. of the normal capacity, and there seems to be little chance of its being increased, despite the efforts being made to speed up consignments of coke from the Ruhr. The quantity coming into this country is about 6000 tons a day, and with the increasing home production and the larger supplies imported the situation is represented in official statements as satisfactory. Unfortunately, the views of the trade do not coincide with this official optimism, although there is a tendency to make the best of things; but there is a growing impression that when the stocks of coke are cleared out of the Ruhr, blast-furnace proprietors will find themselves worse off than ever. The Government has endeavoured this week to infuse confidence by affirming that steps are being taken to ensure the operation of the Ruhr ovens, so that there will be no lack of supplies when the stocks are exhausted, probably at the end of this month; but no intimation is given of the policy to be pursued to attain this end, whether by adopting measures that will convince German operatives that it is to their interest to work or by importing labour to take charge of the ovens. Either alternative presents elements of considerable uncertainty.

Labour.

While there has never been a superabundance of labour in this country, where the majority of the population is engaged in agricultural pursuits, the scarcity of hands has rarely caused so much inconvenience as now, when men are needed in increasing numbers for reconstruction work in the devastated regions. Arrangements have been made for the importation of labour from abroad, chiefly from Poland and Italy, the men being engaged by contract and their expenses paid, and as it appears that they are often induced by other employers to break their contracts by promise of higher pay, the Government has been obliged to intervene and has instructed employers to take proceedings against those who may have tempted foreign hands to change their employment. Should firms working on Government or reconstruction contracts be found guilty of such practices the contracts will be cancelled. Efforts that have been made from time to time since the Armistice to send British unemployed labour into this country have failed, mainly on account of the men being unable to adapt themselves to the living conditions here; but it is stated that a number of unemployed British railwaymen—boilermakers and the like—are to arrive in France, where there is plenty of work for them, and as they are to be housed together it is probable that the experiment will be more successful.

Paris Water Supply.

After investigating for several years the resources of the Vals de la Loire for supplying Paris with water, the Technical Commission of the Municipal Council has at length presented a report entirely favourable to the scheme. The water exists underground for a distance of 50 miles, and it is estimated that the works proposed to be carried out will bring to Paris a million cubic metres —say, 220,000,000 gallons—daily. This will be done by gravitation by means of an aqueduct 109 miles long, of which the cost alone will be 500 million francs. The scheme has met with a great deal of opposition from the local authorities, which feared that the carrying away of such a huge volume of water would drain the subterranean supply and lower the level of the Loire; but extensive pumping operations carried out over a long period have proved that there is no reason to anticipate any falling off in the supply, and as a precaution it is intended to construct barrages at Villerest on the Loire and at Lac d'Issarlès so that sufficient water can be stored up during the winter to be returned to the river in times of drought.

A National Fuel.

The past week has witnessed an active propaganda in favour of a composite motor fuel in which alcohol enters for a sufficiently large part, to ensure the utilisation of the whole of the country's surplus production. While at Toulouse a series of trials of motor vehicles running on an alcohol mixture appear to have given results that will no doubt provide interesting data for the report which will be issued eventually, some demonstrations have been carried out in Paris by the association of growers of beet, grain and other produce, who are endeavouring to support the Government in its efforts to render compulsory an admixture of alcohol with imported spirit. Since the State prohibited the use of alcohol from beet and grain for human consumption and secured a monopoly of its sale for power purposes the stocks have become so enormous that the State has reduced the price paid for future supplies. The Chamber of Deputies has passed a Bill compelling importers of motor fuels to purchase a quantity of alcohol equal to 10 per cent. of their importations, which would about absorb the entire home surplus production; but the Bill is being held up by the Senate on account of the difficulties raised against the 10 per cent. mixture, and the object of the demonstration was to show that a national fuel cannot be successful unless the mixture is at least as cheap for the work done as petrol. It is claimed that this is possible with an equal mixture of petrol and alcohol, while a car has been driven from Paris to Toulouse and back with a fuel composed of 70 per cent. alcohol of 90.5 deg. and 30 per cent. paraffin. The consumption is claimed to have been the same as petrol, and the running was even better, but it is evident that there can be no advantage in point of cost until methods are adopted of dehydrating alcohol on a commercial scale. It is fairly certain that progress is being made with the use of alcohol as a motor fuel, but it is clear that a great deal will yet have to be done before the country can largely reduce its importation of motor fuels. Several scientific bodies are already at work on this problem, and a further creation during the past week by the Minister of Commerce is a consulting scientific committee under the presidency of M. Paul Sabatier, Doyen of the Faculty of Science at Toulouse. Its object is to examine everything that is being done in relation to the natonal resources in hydrocarbons.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

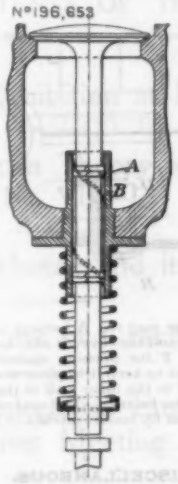
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

196,653. December 23rd, 1921.—IMPROVEMENTS IN VALVES OR GUIDES THEREOF, Arthur John Hawes Elverson, of The Lynch, Clifton-road, Wimbledon, S.W.

The inventor provides the valve stem with a number of rings similar to piston rings A, which engage with the internal wall of

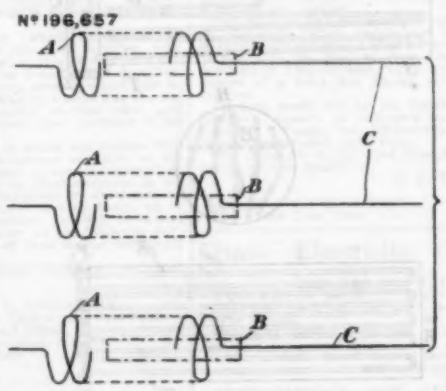


the valve guide. The valve guide is provided with a groove B, which is filled with lubricant, such as graphite.—*April 23rd*, 1923.

DYNAMOS AND MOTORS.

196,657. January 12th, 1922.—IMPROVEMENTS IN THE CONTROL OF ALTERNATING-CURRENT ELECTRIC MOTORS, William Andrews Tester, of Corner House, Commissioner-street, Johannesburg, South Africa, and Sydney Thompson, of City House, Main-street, Johannesburg.

The object of this invention is to minimise or prevent the shock which is imposed upon the windings and the mechanical parts of a motor when the machine is connected to the power supply. The stator windings are connected to the power supply through choke coils with adjustable cores, the arrangement

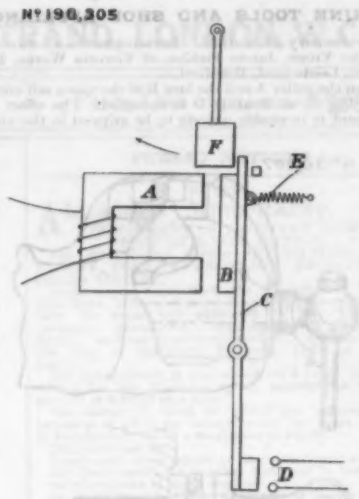


being shown in the accompanying diagram. The choke coils are shown at A and the adjustable cores at B. The mains leading to the stator of the motor are marked C. Any suitable mechanically or electrically operated means may be employed for actuating the adjustable cores. The arrangement can be applied to alternating-current motors of any type.—*April 12th*, 1923.

SWITCHGEAR.

196,305. October 11th, 1921.—IMPROVEMENTS IN AND RELATING TO ELECTRIC RELAYS AND THE LIKE, The British Thomson-Houston Company, 83, Cannon-street, E.C., and Alan Stewart Fitzgerald, of Gable Lodge, Hendon-lane, London, N. 14.

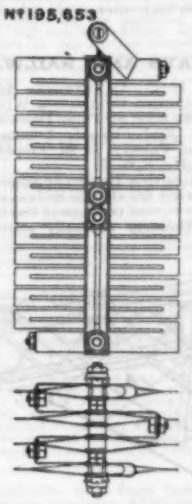
In many cases sensitive relays are subjected to disturbances of large amplitude, but of very short duration, and under such circumstances operation of the relays is undesirable. This invention relates to a relay in which the moving element is prevented from operating on the occurrence of an electromagnetic impulse due to a transient disturbance. In the drawing A is the magnetic core on which is wound the operating winding, which, when energised, attracts the armature B mounted on the moving element C, which is pivoted so as to close the contacts D. The moving element is controlled by a spring E and normally rests against a stop. A mass F is suspended in such a manner that it is displaced against the action of a restoring force by the movement of the armature. Gravity is the restoring force. In the inoperative position, however, the mass should not touch the armature. If a current equal to or exceeding the steady current necessary to trip the relay be maintained for a short period of the order exceeding one or two alternating-current cycles, the relay would trip in the ordinary manner without detriment to its sensitivity. Should, however, the operating winding be affected by momentary or transient currents, the armature will accelerate, striking the mass F, to which it transmits the energy due to the disturbance. The disturbance not persisting, the armature returns to the inoperative position. The energy released by the transient disturbance is



ballistically stored, not in the armature, but in the mass F, the movement of which occurs or persists following the cessation of the disturbance or impulse.—*April 11th*, 1923.

195,653. December 10th, 1921.—IMPROVEMENTS IN THE MANUFACTURE OF GRID RESISTANCES, Leonard Satchwell, of 39, Riversley-road, Nuneaton.

The resistance is built up of stamped grids, and in order to

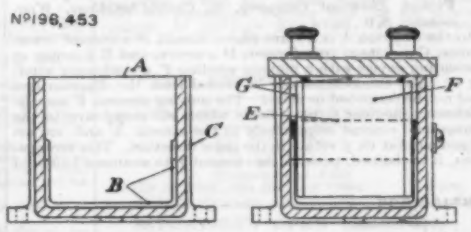


stiffen the resistance, neighbouring lengths of the conductor are bent apart, and an insulated separator is threaded between the splayed lengths.—*March 16th*, 1923.

TELEGRAPHS AND TELEPHONES.

196,453. March 16th, 1922.—IMPROVEMENTS IN OR RELATING TO TRANSFORMERS FOR WIRELESS CIRCUITS, Archibald Parker Welch, of 33, Eastwood-road, Goodmayes, Essex.

This specification describes a low-frequency intervalve transformer. The soft iron casing A is thickened up internally by the



rib B and externally by the rib C. A recess is provided in the inside thickening rib B for the purpose of receiving and supporting the soft iron core E. F is the transformer winding. Insulating compound, such as wax, is placed in the space G.—*April 26th*, 1923.

174,636. January 27th, 1922.—IMPROVEMENTS IN RADIO RECEIVING SYSTEMS, Gesellschaft für Drahtlose Telegraphie m.b.H., of 9, Tempelhofer Ufer, Berlin, Germany.

It has been proposed to protect a radio receiving system from disturbing influences by means of a rejector circuit comprising a condenser and an inductance, and it is known that the smaller the damping of such circuit the greater the protection. According to this invention a rejector circuit in a radio receiving system is connected to a valve amplifier in such a way that its damping is reduced. This has the advantage that the inductance coil of the rejector circuit may be formed of fine wire regardless of the damping effect of this fine wire, the damping being reduced by the amplifier. Thus the coil may be made so small that it may easily be shielded in a metal box, so that it is completely immune from the effect of stray oscillations and the interaction of neighbouring coils. As an example an inductance coil suitable for a rejector circuit with a wave length of 1000 m. is considered. Formerly such a coil was made of stranded wire composed of 270 wires, each of about 0.07 mm. diameter, each wire being individually insulated with enamel. The coil consisted of seventy-eight turns in two layers, say, 90 mm. long, and its diameter was 100 mm. Such a coil had about 500,000 cm. inductance and was connected with a perfect air condenser of 800 cm. to 1000 cm. In place of such a bulky coil it is possible, according to this invention, to use a coil formed of a single copper

wire 0.2 mm. in diameter, the length of the coil being from 1 mm. to 1.5 mm., its internal diameter 10 mm., and its external diameter 30 mm. to 32 mm.—*April 27th*, 1923.

MACHINE TOOLS AND SHOP APPLIANCES.

196,387. January 24th, 1922.—IMPROVEMENTS IN AND RELATING TO VICES, James Pickles, of Victoria Works, Lawrel-street, Leeds-road, Bradford.

Between the collar A and the face B of the vice a self-contained ball or roller thrust bearing D is mounted. The effect of this arrangement is to enable objects to be gripped in the vice con-

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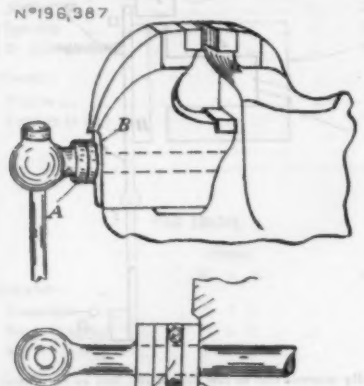

siderably tighter than usual, and the releasing power is also considerably decreased. The device, it is said, may be fitted to any ordinary vice with but little alteration.—*April 24th*, 1923.

TRAMWAYS AND RAILWAYS.

196,528. July 26th, 1922.—AN IMPROVED ARRANGEMENT FOR SUSPENDING OVERHEAD CONDUCTOR WIRES ON ELECTRIC RAILWAYS AND THE LIKE, Sir Philip Dawson, of St. Stephen's House, Victoria Embankment, London, S.W. 1; and Frederick William Fawdry, of 36, Emperor's Gate, South Kensington, London, S.W. 7.

This invention relates to a triangular suspension system for overhead conductor wires for electric railways. The conductor wire is supported over curved portions of track by one catenary wire disposed approximately vertically above the conductor

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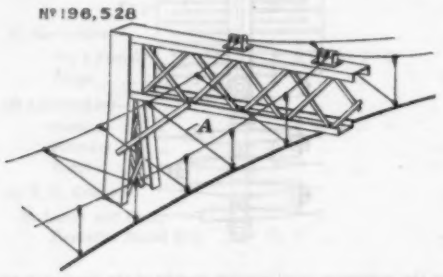

wire and a second catenary wire slewed in relation to the conductor wire, to which it is connected by dropper wires A adjustable in length for the purpose of curving the conductor wire, whilst employing equi-spaced supporting structures throughout the length of the track.—*April 26th*, 1923.

MEASURING AND TESTING INSTRUMENTS.

196,525. July 22nd, 1922.—IMPROVEMENTS RELATING TO ELECTRIC MEASURING INSTRUMENTS, *The Metropolitan-Vickers Electrical Company, 4, Central-buildings, Westminster, S.W.*

In the diagram A is a three-phase circuit, B a current transformer, C a voltage transformer, D a meter, and E a motor or translating device with a moving winding F, a stationary winding G. The connections can be traced from the diagram and need not be described in detail. The moving element F and the stationary member G have fields which are responsive to the voltage and current respectively in the circuit A and are arranged so that they rotate in the same direction. This arrangement, it is claimed, permits the element F to assume a balanced

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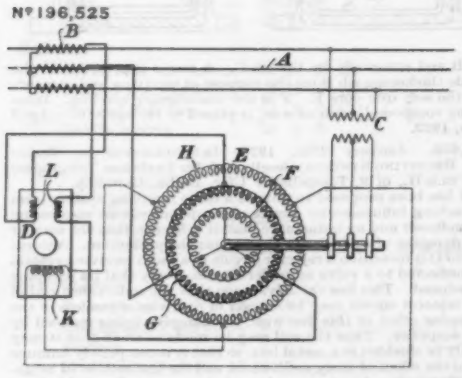

phase relation or position of no torque in relation to the stationary winding G. Thus, if the phase relation between the current and voltage of the circuit A should change in either direction the element F will immediately assume a position of no torque with respect to the winding G or a position indicative of the power of the circuit. The device E is provided with a secondary stationary element or winding H, which is connected to the voltage element K of the meter D. The windings F and H being related to each other similarly to the primary and secondary windings respectively of a transformer, it follows that the winding H will be at all times energised in accordance with the voltage impressed on the circuit A with a definite phase relation with respect to the current traversing the circuit A. Since the current element L of the meter is energised in accordance with the current of the circuit A and the voltage element K is energised from the winding H in accordance with the voltage of the circuit A and in definite phase relationship with the current traversing the winding L, the meter will at all times accurately measure the volt-ampères irrespective of the power factor of the circuit A.—*April 26th*, 1923.

MOTOR CARS AND ROAD TRAFFIC.

195,361. February 23rd, 1923.—IMPROVEMENTS IN AND CONNECTED WITH TOOL, BATTERY AND THE LIKE BOXES FOR MOTOR VEHICLES, Daimler-Motoren-Gesellschaft of Fabrikstrasse, Untertürkheim, Stuttgart, Germany.

The step A of the car is supported from the frame member by means of bearers B, and a sheet metal box C is supported on the depressed portion of the bearer and against the side face of the frame member. The cover D for the box C is formed by a portion of the sheet metal covering or valance extending between the

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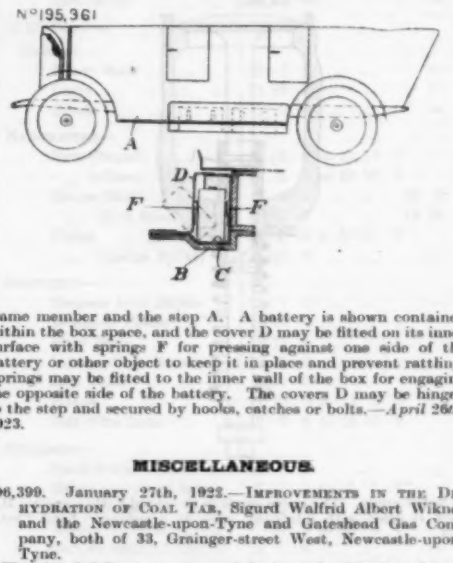

frame member and the step A. A battery is shown contained within the box space, and the cover D may be fitted on its inner surface with springs F for pressing against one side of the battery or other object to keep it in place and prevent rattling. Springs may be fitted to the inner wall of the box for engaging the opposite side of the battery. The covers D may be hinged to the step and secured by hooks, catches or bolts.—*April 26th*, 1923.

MISCELLANEOUS.

196,399. January 27th, 1923.—IMPROVEMENTS IN THE DEHYDRATION OF COAL TAR, Sigurd Walfrid Albert Wikner and the Newcastle-upon-Tyne and Gateshead Gas Company, both of 33, Grainger-street West, Newcastle-upon-Tyne.

The pipe A delivers an excess of the tar to be dehydrated from a reservoir into a chamber B provided with an overflow C, from which any surplus tar delivered passes back to the reservoir. This chamber communicates through a pipe D with the bottom of a closed tank or boiler T, the level of the tar in which is therefore kept constant at the level of the overflow C. Just below the

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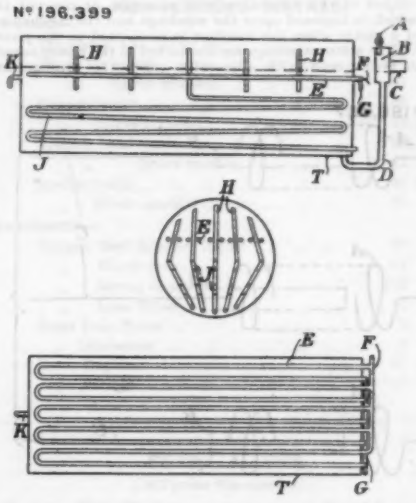

level of the tar is a series of pipes E, to which steam can be introduced through a pipe F and from which it passes away through a pipe G. The water vapour and any other vapour which are driven off from the tar by the heat of the pipes E pass down through pipes H to coils J, in which the vapours are condensed so that no heat is lost, and the condensed vapours flow away from these coils J, which may be connected, if desired, to a small condenser. The dehydrated tar issues from the tank through a pipe K.—*April 26th*, 1923.

196,357. January 19th, 1922.—IMPROVEMENTS IN THE RECOVERY OF FIXED ATMOSPHERIC NITROGEN, Thomas Twynam, "Teeswold," Coatham-road, Redcar.

This invention relates to improvements in the fixation of nitrogen in the form of nitrous or nitric acid or mixtures of the same. It is well known that when a high-tension electric spark is passed through atmospheric air some of the nitrogen and oxygen combine to form nitric oxide, which, on cooling and in the presence of water or steam, is eventually converted largely into nitric acid. This method of combining nitrogen requires special and expensive plant, and the efficiency is low, so that unless electric power is very cheap the process is not economical. In large gas engines actuated by the explosion of coke-oven gas, where the initial pressure is high, the inventor has found that after the explosion a certain amount of nitric oxide or other compounds of nitrogen and oxygen are formed, which pass out with the escaping hot gases. If these gases are cooled and mixed with a jet of water or steam and scrubbed, the nitrogen compounds are capable of being condensed in the towers or other apparatus used, much in the same way as the nitric or nitrous acids are condensed in the arc process. High compression in the cylinders and high temperature therein, and also some excess of air over the theoretical quantity required for the explosion, are all advantageous factors in increasing the yield of combined nitrogen. In some cases also, air, to which oxygen has been added above that usually present, may be used to increase the yield. It is essential that the explosion temperature should be high, and for this reason the use of large engines actuated by the explosion of blast-furnace gas by itself has not been found to give satisfactory results, the amount of fixed nitrogen being small. With coke-oven gas, however, a sufficiently high explosion temperature is obtained to bring about the required reaction. The waste gas escaping from the cylinders contains both nitric and sulphuric acids after cooling, and acts on ordinary iron or steel apparatus, so that alloy steels or high-silicon iron should be made use of in the condensing apparatus. It is found that steel containing about 12 per cent. chromium with low carbon is practically unacted upon by nitric acid. The waste gases are best cooled by passing through the flues of boilers for the purpose of raising steam, &c. The mixture of nitric and sulphuric acid may be separated by boiling off the nitric acid in the usual way.—*April 19th*, 1923.

196,487. May 8th, 1922.—IMPROVEMENTS IN IMPACT PULVERISERS, Maxwell McGinness, of 2, Gresham-buildings, Basinghall-street, E.C. 2.

The pulveriser described in this specification consists of two rotary beater devices driven in opposite directions in casings arranged side by side with their exit passages directed towards one another and communicating with a common whirling and

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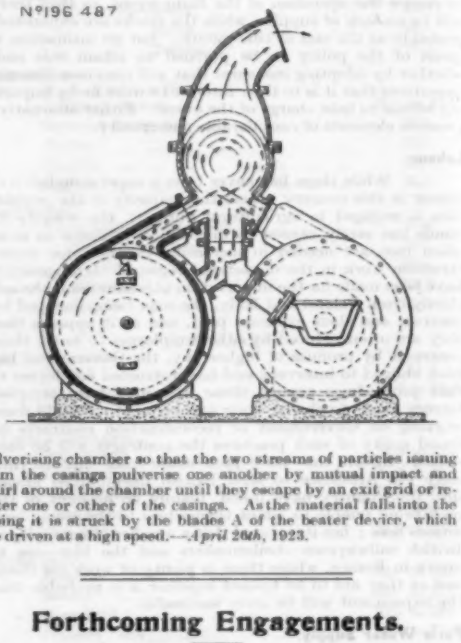

pulverising chamber so that the two streams of particles issuing from the casings pulverise one another by mutual impact and whirl around the chamber until they escape by an exit grid or re-enter one or other of the casings. As the material falls into the casing it is struck by the blades A of the beater device, which are driven at a high speed.—*April 26th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North-Western District meeting. Town Hall, Rochdale. 2.45 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Radiation of Light," by Professor H. A. Lorentz. 9 p.m.

TUESDAY TO FRIDAY, JUNE 5TH TO 8TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Summer meeting at Manchester. For programme see page 322.

WEDNESDAY, JUNE 6TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Wireless Section meeting. "Wireless Direction Finding in Steel Ships," by Mr. C. F. Horton. 6 p.m.

FRIDAY, JUNE 8TH.

INSTITUTION OF CHEMICAL ENGINEERS.—The Engineers' Club, Coventry-street, W. 1. Annual corporate meeting. Paper, "Industrial Oxygen," by Mr. T. C. Finlayson, 5 p.m. Informal dinner, 8 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "Jewels of the Renaissance," by Miss Joan Evans. 9 p.m.

SATURDAY, JUNE 9TH.

OPTICAL SOCIETY.—Visit to the Royal Observatory, Greenwich. 3 p.m.

THURSDAY TO SATURDAY, JUNE 14TH TO 16TH.

INSTITUTE OF TRANSPORT.—Summer Meeting in Sheffield.

MONDAY TO FRIDAY, JUNE 25TH TO 29TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer Meeting in Glasgow.

THE ELECTRONIC THEORY OF VALENCY.—We are asked to make a preliminary announcement regarding the general discussion on the electronic theory of valency, which is being arranged by the Faraday Society, to be held at Cambridge on July 13th and 14th. Professor G. N. Lewis will open the proceedings on the Friday afternoon with a general introductory address, and he will probably be followed by Mr. R. H. Fowler, who will contribute a paper intended to open discussion on the physical and inorganic side of the subject. Among those expected to speak are Sir J. J. Thomson, who will be in the chair, Sir Ernest Rutherford, Sir Wm. Bragg, and Professor W. L. Bragg. The Saturday morning session will be devoted chiefly to a discussion of the applications of the theory in organic chemistry. Sir Robert Robertson, president of the Society, will preside, and opening papers will be given by Professor T. M. Lowry and Dr. N. V. Sidgwick. Among those expected to speak are Professor W. A. Noyes, Sir Wm. Pope, Professor A. Lapworth, Professor I. M. Heilbron, Dr. W. H. Mills, Professor J. F. Thorpe, and Professor R. Robinson. On the Friday evening a complimentary dinner will be given to Professors Lewis and Noyes and other guests at Trinity Hall. Arrangements are being made to accommodate those attending the meeting in one or other of the Colleges, and it will be possible to include a limited number of non-members of the Society. Particulars may be obtained from the secretary of the Faraday Society, 10, Essex-street, London, W.C. 2, to whom applications should be made at once.